



COUNTY *of* SAN DIEGO TRAUMA SYSTEM ASSESSMENT STUDY 2003





San Diego County Trauma System Assessment Study

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Prepared for:
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Prepared by:
The Abaris Group



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San Diego County Trauma System Assessment Study

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Executive Summary

Trauma care has been a significant part of the San Diego healthcare landscape for 20 years. San Diego's trauma system is considered by many to be one of the finest systems in the country. Early leadership was demonstrated by the County Board of Supervisors, EMS Agency, hospitals and the Hospital Council of San Diego and Imperial Counties by developing one of the first trauma systems in the country.

San Diego's trauma system began in 1982 when the Hospital Council of San Diego and Imperial Counties conducted an assessment to decide whether a trauma system would benefit San Diego. The resulting study led to development of the County's trauma care plan. Many refinements have been made to the trauma system during its 18-year existence. This study was designed to evaluate the current system's capabilities and performance and make recommendations for the future.

The current trauma system treats in excess of 9,500 patients per year - with that volume expected to grow to 13,200 over the next seven years. The trauma patient is served by a network of 18 9-1-1/PSAPs (public safety answering points), 24 basic and advanced life support services (both ground and air), 8 base hospitals and 6 trauma centers. These components form the framework of the trauma system delivery network with supervision and leadership coming from the San Diego County EMS Agency.

The County of San Diego and the community of San Diego should be amply reassured that the network of prehospital providers and trauma centers provides high-quality, state-of-the-art care. The system is supervised by a state-of-the-art EMS Agency. The community should have confidence that the trauma system continues to provide a superior level of service to its residents.

Quality achievement is a pervasive theme

among the trauma centers, and the commitment at the County and provider levels is also excellent. In particular, the trauma center program managers and medical directors and the County operate as a cohesive group. It is this cohesiveness that allows the candor and self-examination which is the backbone of the trauma center quality review process.

The Abaris Group is unaware of any other trauma system in the country where there has remained, over time, the sense of mutual commitment and depth of quality review as has been demonstrated in San Diego.

There are emerging challenges for assuring a stable network of trauma centers in San Diego and in the country:

- Growing demand for services, coupled with diminishing capacity;
- Lack of adequate funding and compensation for emergency and trauma-related services;
- Shortages in available workforce; and
- Increases in the cost of liability insurance for hospitals and physicians.

Key to these challenges are the ongoing staffing challenges for physician specialists at trauma centers. While this physician coverage has stabilized, this issue remains a serious threat to the San Diego trauma network. Ongoing system and hospital strategic planning will be needed to prevent further physician issues and to mitigate the effects of the other stability challenges described in the report.

With a trauma network as experienced as San Diego's, system stakeholders are also eager for continued improvements commensurate with assured quality and cost efficiencies. There is also a significant desire to see a financially stable trauma system for the future.



“Confirming the infrastructure of the trauma system and addressing the recommended refinements in this report will assure a quality and stable trauma system for San Diego’s future.”

The Abaris Group has summarized the key recommendations on system improvements that meet these goals:

- (1) Refinement of the Medical Audit Committee (MAC) is recommended to assure continued relevance, appropriate resource utilization and the identification and management of system trends and strategic issues.
- (2) A comprehensive review of the trauma triage criteria is needed to verify assumptions on over-and under-triage and to assist with resource allocation.
- (3) An effort should be made to improve the coordination and focus of prevention efforts to target more trauma center epidemiological and strategic initiatives and assist with reducing duplication.
- (4) A single, synchronized, system-wide and state-of-the-art trauma registry is needed.
- (5) Increased coordination efforts are needed with the prehospital stakeholders to allow for improved interfaces between the trauma and prehospital care systems.
- (6) No changes are recommended to the trauma center configuration in terms of number of centers and their location but contingency planning should occur, if there is an unforeseen change with the number of trauma centers.
- (7) A complete strategic planning process should be developed that encompasses trauma system expectations, leadership needs, expectations of the County and the resources needed to assure a stable trauma system for the future.
- (8) There is a need to create a linked and integrated information and surveillance system that meets the priority goals of the trauma system.

- (9) Financial planning needs to occur at the trauma center and system levels to assure an ongoing stable and financially secure trauma system.

Confirming the infrastructure of the trauma system and addressing the recommended refinements in this report will assure a quality and stable trauma system for San Diego’s future.



“The interviews, town hall meetings and ride-alongs ultimately resulted in input from greater than 220 system stakeholders whose information, comments and opinions were carefully inventoried for this study.”

I. Overview

Purpose

The Abaris Group was retained by the San Diego County Board of Supervisors to assess and analyze the operations of the San Diego County Trauma System and develop recommendations to improve the system's operation and long-term stability. This assessment was based on analyzing various data and obtaining information, reviewing reports, conducting extensive interviews of system stakeholders including representatives of the County, the designated trauma centers and other key system stakeholders, including fire, ambulance and other prehospital care providers, other non trauma center hospitals, and residents of San Diego.

Methods

The Abaris Group developed a detailed workplan for the project which was approved by the County of San Diego. During the study phase, The Abaris Group conducted an in-depth inventory of the six trauma centers and of the trauma system's Medical Audit Committee process. An extensive number of interviews were conducted and five town hall meetings of system stakeholders were completed. In addition, four paramedic unit "ride-alongs" were conducted representing different geographic regions of the county. The interviews, town hall meetings and ride-alongs ultimately resulted in input from greater than 220 system stakeholders whose information, comments and opinions were carefully inventoried for this study. A project web site also was established, allowing 24-hour access to project details and documents. In addition to the interview and site visit processes, The Abaris Group conducted a review of the literature, interviewed other trauma systems and reviewed and analyzed a number of databases.

A key component of the study methodology was development of a baseline review and inventory of the trauma system and its components.

The results of the inventory were published in the Trauma System Current Status Report delivered to the County of San Diego in November, 2002.

This report summarizes the observations and conclusions of the trauma system study by The Abaris Group.



Trauma System Development

Trauma System Defined

A trauma system may be defined as a multidisciplinary effort by a region to respond to the risk and occurrence of injury by coordinating resources throughout the care spectrum. Such a system often involves the participation of the local public health system, emergency medical services (EMS), designated trauma centers, rehabilitative care and injury prevention programs. Trauma systems are developed with an expectation that these efforts will lead to significant reductions in morbidity and mortality.

The National Highway Traffic Safety Administration's (NHTSA) publication *Trauma System Agenda for the Future*¹ defines the infrastructure and fundamental components of a trauma system:

- Acute Care Facilities
- Disaster Preparedness and Response
- Education and Advocacy
- Finances
- Information Management
- Injury Prevention
- Leadership
- Post-Hospital Care
- Pre-Hospital Care
- Professional Resources
- Research Technology

The American College of Surgeons *Consultation for Trauma Systems*² document, in general, mirrors the NHTSA model trauma system components but specifies important details on such topics as system development, legislation and research. This document additionally outlines credentialing steps needed to identify progress and the status of each of the key

trauma system components.

The trauma system components identified by these documents form the backbone of any quality trauma system in the country.

National Overview

It has only been in the past approximately 20 years that highly developed trauma systems have existed at all. There was some impetus for their development as early as the late 1950s and early 1960s, with the publication of research studies reporting a need for improved emergency treatment of injuries.^{3,4} The benefits of immediate treatment of injuries also became better known from the experience of treating injured soldiers during the Korean and Vietnam wars. However, the first major step toward developing trauma systems came in 1966, when the National Academy of Sciences and National Research Council published a white paper entitled *Accidental Death and Disability: The Neglected Disease of Modern Society*.⁵ This report identified this country's significant deficiencies in the provision of care for injured patients and was instrumental in spurring the development of systems of trauma care. That same year, the 1966 Highway Safety Act was enacted, reinforcing the states' authority to set standards, regulate EMS and implement programs designed to reduce injury.

In the early planning years, urban hospitals affiliated with medical schools had the staffing resources to provide timely treatment of injuries, but others did not. Illinois was a leader in establishing designated trauma centers in both urban and rural areas. In the following years, Maryland established the Maryland Institute for Emergency Medical Services Systems (MIEMSS) and the first statewide trauma system.

1 "Trauma System Agenda for the Future", National Highway Traffic Safety Administration, Washington DC: October 2002.

2 "Consultation for Trauma Systems", American College of Surgeons, Chicago, IL, 1998.

3 Root GT, Christensen BH: Early Surgical Treatment of Abdominal Injuries in the Traffic Victim. *Surg Gynecol Obstet* 105:264, 1957.

4 Van Wagoner FH: Died In a Hospital-A Three Year Study of Deaths Following Trauma. *J Trauma* 1:401, 1961.

5 National Academy of Sciences and National Research Council, "Accidental Death and Disability: The Neglected Disease of Modern Society". Washington, DC, 1966



In 1973, the Emergency Medical Services Act (P.L. 93-154) was enacted to stimulate the development of regional EMS systems. This act contributed significantly to the growth of the EMS infrastructure. Fifteen program components were recognized as essential elements of an EMS system, including clear identification of target efforts for developing trauma systems. During 1981, this program ended and was folded into the Preventive Health and Human Services (PHHS) Block Grant Program.

Studies done in the late 1970s revealed high rates of preventable injury deaths. In 1983 West, et al, conducted a comparison of preventable death rates pre- and post-trauma system implementation and found a reduction from 73 percent to 9 percent.⁶ Numerous additional studies have supported these conclusions.

In 1985, the National Research Council and Library of Medicine published another white paper entitled *Injury in America—A Continuing Public Health Problem*.⁷ Their report concluded that more needed to be done for injury control. The report advocated increased resources for injury prevention and led to the creation of an injury prevention center under the Centers for Disease Control (CDC). Additional Injury Control Research Centers have since been established throughout the country.

After much debate and planning, The Trauma Care Systems Planning and Development Act of 1990 (P.L.101-590) was passed. The Act encouraged state governments to develop, implement and improve regional trauma systems. The primary focus of the Act was the development by each state of a trauma care plan that takes into account national standards for the design-

nation of trauma centers and for patient triage, transfer and transportation policies. Additionally, the Act created a Division of Trauma and EMS (DTEMS) under the Health Resources and Services Administration (HRSA). Funding was suspended in FY1995 but returned in FY2001. Two important achievements of the DTEMS have been the development of a *Draft Model Trauma Care System Plan* and establishment of competitive planning grants for statewide trauma system development.⁸ This *Draft Model Trauma Care System Plan* has been instrumental in establishing guidelines for trauma system development throughout the country.

In 1999, the Institute of Medicine published *Reducing the Burden of Injury: Advancing Prevention and Treatment*, which found evidence of progress in preventing and treating injury, but advocated increased federal funding for greater improvements.⁹

At the trauma center level, the American College of Surgeons Committee on Trauma (ACSCOT) has played a key role in establishing guidelines. The ACSCOT published the first guidelines for the designation of trauma centers in 1976, in a publication entitled *Optimal Hospital Resources for Care of the Seriously Injured*.¹⁰ These guidelines have been periodically updated and were most recently published in 1999 as *Resources for Optimal Care of the Injured Patient*.¹¹ In 1987, the ACSCOT also began a program in which the American College of Surgeons (ACS) provided evaluation of trauma centers, and more recently published *Consultation for Trauma Systems*, a set of guidelines for evaluation and improvement of trauma systems.¹²

6 West JG, Cales RH, Gazzaniga AB: Impact of regionalization—The Orange County experience. Arch Surg 118:740, 1983.

7 National Research Council and Library of Medicine. "Injury in America - A Continuing Public Health Problem". Washington, DC, National Academy Press, 1985.

8 Health Resources and Services Administration. "Draft Model Trauma Care System Plan". Rockville, MD, Health Resources and Services Administration, 1992.

9 Committee on Injury Prevention and Control, Institute of Medicine. "Reducing the Burden of Injury: Advancing Prevention and Treatment". Washington, DC, National Academy Press, 1999.

10 "Optimal Hospital Resources for Care of the Seriously Injured". Bulletin of the American College of Surgeons, 61:15-22, 1976.

11 American College of Surgeons Committee on Trauma: "Resources for Optimal Care of the Injured Patient". Chicago, American College of Surgeons, 1998.

12 American College of Surgeons Committee on Trauma: "Consultation for Trauma Systems". Chicago, American College of Surgeons, 1998.



Exhibit 1

United States Trauma Centers

- 192 Level I
- 261 Level II
- 242 Level III
- 451 Levels IV and V
- 3 Unspecified
- 1,149 Total

Source: American Trauma Society, 2002 Survey

Today, nationwide there are 1,078 designated trauma centers (35 states) and 1,149 designated or verified trauma centers (including the 15 states with 71 verified but not designated trauma centers).

Other important guidance on trauma systems has come from the American College of Emergency Physicians (ACEP) and NHTSA, as noted above. In 1987, ACEP published *Guidelines for Trauma Care Systems*, which provides guidance on all elements of trauma system care.¹³ NHTSA developed the first national guiding document on trauma systems through its publication *Development of Trauma Systems: A State and Community Guide*.¹⁴ This document was the predecessor to the *Model Trauma System Plan* also mentioned above. NHTSA established the Statewide Technical Assessment Program, through which “technical assistance teams” were invited to review the EMS and trauma systems of states across the country. Three technical assistance workshops were conducted, including one in California. In addition, the Development of Trauma Systems Course by NHTSA was established to further assist the states.

In 1987, West, et al, defined eight trauma system components and conducted a nationwide survey of trauma system development.¹⁵ The components were: legal authority to designate trauma centers, a formal process for designation, use of ACS standards for trauma centers, out-of-area survey teams for trauma center designation, designation based on need, written triage criteria, ongoing monitoring of trauma centers, and full state coverage by trauma centers. The survey found that only Maryland and Virginia had all

components including statewide coverage, 19 states and the District of Colombia lacked one or more of the components for a trauma system and 29 states had not yet begun any process for trauma system development. In a 1993 survey, Bazzoli, et al, found that the number of states with complete trauma systems had increased to five,¹⁶ and a 1998 survey conducted by Bass, et al, found that in addition to the 5 states meeting all 8 criteria, 28 states met 6 to 7 component criteria, another 10 had less than 5, and 8 states had no trauma system components.¹⁷

California Overview

The California Legislature established the authority for trauma system planning in 1984. The purpose of this statutory authority was to encourage development of trauma care systems throughout the state. During 2001, the Legislature passed AB1430 which reinforced the goal of a state-wide trauma network. This legislation also approved funding for additional trauma planning and for support to designated trauma centers.

California trauma systems are regulated under the California Code of Regulations, Title 22, Division 9, Chapter 7. These regulations define the requirements for trauma systems as well as trauma centers in California. In addition, they describe the roles of the local emergency medical services (EMS) agency and the California Emergency Medical Services Authority (EMSA) in devel-

13 American College of Emergency Physicians: “Guidelines for Trauma Care Systems”. Ann Emerg Med 16:459, 1987.

14 “Development of Trauma Systems: A State and Community Guide”. Washington, DC: NHTS, Washington DC.

15 West JG, Williams MJ, Trunkey DD, Wolferth CC: Trauma systems: Current status - Future Challenges. JAMA 259:3597, 1988.

16 Bazzoli GJ, Madura KJ, Cooper GF, et al: Progress in the Development of Trauma Systems in the United States. JAMA 273:395, 1995.

17 Bass RR, Gainer PS, Carlini AR: Update on Trauma System Development in the United States. JTrauma. 47:S15, 1999.



oping local trauma systems. California trauma regulations do not require trauma systems and trauma centers but merely stipulate the requirements for such a system if established.

The EMSA provides statewide coordination and leadership for the planning, development and implementation of local trauma care systems. EMSA responsibilities include developing statewide standards for trauma care systems and trauma centers, the provision of technical assistance to local agencies; developing, implementing, or evaluating components of a trauma care system, and the review and approval of local trauma care system plans to ensure compliance with the minimum standards set by the EMSA.¹⁸ The trauma plan requirements in California address all of the issues identified by the NHTSA and ACS documents described above.

Local EMS agencies are responsible for planning, implementing, and managing local trauma care systems, including assessing needs, developing the system design, designating trauma care centers, collecting trauma care data, and providing quality assurance.

Currently, California has trauma systems in 20 of its EMS regions, and the goal is that the remaining 12 regions will develop, or finish developing, systems in the near future. There are currently 58 trauma centers across California, including 14 with Level I designation, 31 at Level II, 7 at Level III, and the remaining 6 at Level IV.

San Diego County Trauma System

History of San Diego Trauma

Trauma care has been a significant part of the San Diego healthcare landscape for 20 years. San Diego's system is considered by many to be one of the finest systems in the country. Early leadership was demonstrated by the County Board of Supervisors, EMS Agency, hospitals and the Hospital Council of San Diego and Imperial Counties by developing one of the first trauma systems in the country.

The San Diego trauma system began in 1982 when the Hospital Council of San Diego and Imperial Counties conducted an assessment to decide whether a trauma system would benefit San Diego. The resulting study, *The Trauma Needs Assessment Study* by Amherst & Associates, led to developing the County's trauma care plan.¹⁹ The Amherst Study revealed that 46.9 percent of trauma patients studied received suboptimal care and that 21.2 percent of the deaths were either frankly or potentially preventable.

In 1983, an ad hoc Trauma Advisory Task Force was created to further advance the County's efforts in formalizing a trauma system. Their recommendations included adopting trauma standards which closely followed the American College of Surgeons guidelines for optimal care of the injured patient. A year later, the trauma system was approved by the San Diego County Board of Supervisors.

In 1992, the San Diego County Board of Supervisors reconvened the Trauma Advisory Task Force to analyze the operation of the system and develop recommendations to improve the system's operation and long-term stability. The Trauma

¹⁸ California Code of Regulations, Title 22, Division 9, Chapter 7.

¹⁹ Amherst & Associates, Inc.: "Trauma Needs Assessment Study". Prepared for the Hospital Council of San Diego and Imperial Counties, 1982.



Advisory Task Force was comprised of approximately 75 system stakeholders. The task force was divided into four subcommittees – fiscal, clinical, systems and legal – each of which reviewed and made recommendations on a set of “critical questions” pertinent to that subcommittee. Essentially, they found that the trauma system worked well and did not need any major changes. The task force also made several recommendations for consideration throughout the San Diego County trauma care community.

These two studies and others in San Diego have contributed to many other trauma systems in the country. A number of the individual trauma system stakeholders have made significant additional contributions to trauma systems throughout the U.S. These include extensive participation in development of the Model Trauma Plan and its roll out (Cooper, Eastman and Hoyt), system site visits (Cooper, Eastman, Hoyt and Sise) and early involvement in the California trauma system regulations (Cooper, Eastman and Hoyt).

David Hoyt, MD and other local trauma stakeholders have an ongoing role in the development of a California Trauma System Plan now under development.

Ten years later, in 2002, the Board of Supervisors requested a further review of the trauma system and retained The Abaris Group to conduct this third assessment.

Outcome Changes

A clear affirmation of the success of the San Diego trauma system is the significant

decrease seen in the number of preventable deaths and the generally improved care that has resulted since implementing the trauma system. Two important studies examining outcome changes have been conducted in San Diego. The first study, conducted by Shackford, et al, in 1984, compared the trauma system before implementation and after.²⁰ This study used data from the original Amherst Study for the pre-trauma center system analysis but followed a more stringent review process of that data. The same review process was then used for the post-trauma center implementation portion of the study.

The “before” and “after” study demonstrated that before the trauma system was regionalized, the care of major trauma victims was considered suboptimal in 32 percent of cases. After the system was

Exhibit 2 - Rates of Suboptimal Care and Preventable Death Before and After Trauma System Implementation

San Diego Trauma Center Network			
Before		After	
Suboptimal Care	Preventable Death	Suboptimal Care	Preventable Death
32%	13.6%	4.2%	2.7%

Source: Shackford, Hollingsworth-Fridlund, Cooper and Eastman, 1986

regionalized, the number of patients who received suboptimal care dropped to 4.2 percent. With respect to preventable deaths, before the system was regionalized, 13.6 percent of major trauma deaths were identified as “preventable.” After regionalization, “preventable” deaths dropped to 2.7 percent.

The projected annualized number of “frankly preventable” deaths identified during the Amherst Study (1982) that survived after trauma center designation (1984) was 28.8 patients per year. Assum-

20 Shackford SR, Hollingsworth-Fridlund P, Cooper GF, Eastman AB: The Effect of Regionalization upon the Quality of Trauma Care as Assessed by Concurrent Audit before and after Institution of a Trauma System: A Preliminary Report. J Trauma 26:812, 1986.



“It is believed by system stakeholders that all of these components and others have contributed to the culture of quality review and the overall success of the San Diego County trauma system.”

ing the same preventable death rate after designation, with no adjustments for volume growth, the number of saved lives would be 518 during the trauma center network’s 18 year existence.²¹

In 1986 a second study was conducted by Shackford, et al, to understand the outcomes at hospitals that were not trauma centers versus those that were.²² The results showed that the percent of preventable deaths occurring at non-trauma hospitals was 7.6 percent, while at trauma centers it was 2 percent. The data and evidence that resulted from both of these studies have helped propel and propagate trauma systems throughout the country.

Two other highly successful components of the San Diego County trauma system include the Medical Audit Committee (MAC) and the highly collaborative nature within the trauma stakeholder groups. MAC is the trauma system quality assurance committee that includes the trauma medical directors and the trauma program managers from each trauma center, among others. While MAC meets monthly, every other month they meet to discuss trauma cases, with candid discussion of case treatment between the peer trauma centers. On the alternate months the committee discusses administrative and system issues.

The high level of collaboration among the key trauma stakeholders has been identified as a unique strength of the San Diego system. It is apparent that the trauma medical directors and trauma program managers confer regularly even outside of the MAC process on important trauma center issues. In addition, many other key stakeholder groups communicate regularly, including the sister committee to MAC, the Prehospital Audit Committee (PAC). The PAC generally operates simi-

larly to MAC, but has a wider participation base (ambulance providers, emergency department physicians, base hospital coordinators, etc.).

It is believed by system stakeholders that all of these components and others have contributed to the culture of quality review and the overall success of the San Diego County trauma system.

San Diego Trauma Today

The San Diego trauma system is comprised of five adult and one pediatric trauma center. Trauma center admissions

Exhibit 3 - San Diego Trauma Centers

San Diego County Trauma System	
Trauma Centers	Level
Children's Hospital & Health Center	II
Palomar Medical Center	II
Scripps Memorial Hospital - La Jolla	II
Scripps Mercy Hospital & Medical Center	II
Sharp Memorial Hospital	II
UCSD Medical Center	I

have steadily increased since the system’s inception. From fiscal year 85/86 to fiscal year 01/02, trauma center admissions have risen 118 percent. The average annual growth rate has been 7 percent per year. Exhibit 4 shows the number of trauma center admissions by fiscal year, the monthly average, the percent change and the utilization rate per 100,000 population. With the steady rise in trauma cases, the utilization rate is also increasing. In fiscal year 85/86 the utilization rate (number of trauma cases per 100,000 population) was 203.6. For fiscal year 01/02 the utilization rate was 327.1.

²¹ Based on calculations by The Abaris Group.

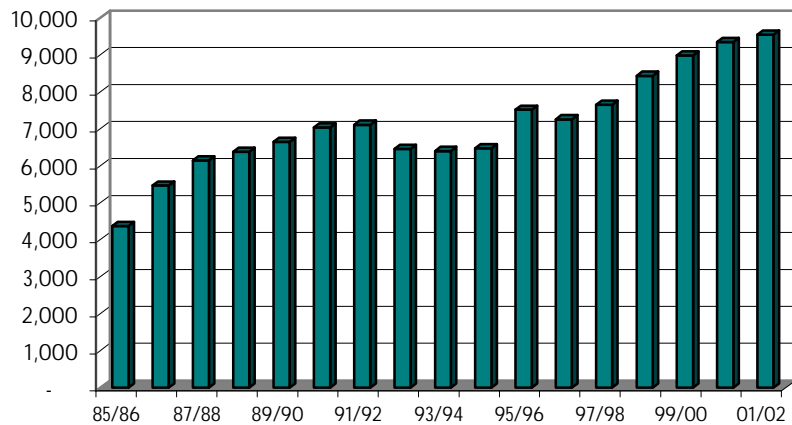
²² Shackford SR, Hollingsworth-Fridlund P, McArdle, Eastman AB: Assuring Quality in a Trauma System - The Medical Audit Committee: Composition, Cost, and Results. J Trauma 27:866, 1987.



Exhibit 4 - Trauma Center Admissions by Fiscal Year

Trauma Center Admissions by Fiscal Year				
Fiscal Year July - June	Trauma Center Admissions	Monthly Average	Percent Change	Rate per 100,000 Population
85/86	4,374	365	-	203.6
86/87	5,466	456	25%	245.8
87/88	6,148	512	12%	267.2
88/89	6,379	532	4%	267.1
89/90	6,650	554	4%	268.1
90/91	7,036	586	6%	277.1
91/92	7,111	593	1%	275.3
92/93	6,460	538	-9%	247.1
93/94	6,399	533	-1%	242.5
94/95	6,474	540	1%	243.5
95/96	7,516	626	16%	279.4
96/97	7,257	605	-3%	266.4
97/98	7,653	638	5%	273.8
98/99	8,435	703	10%	295.6
99/00	8,984	749	7%	308.6
00/01	9,351	779	4%	327.0
01/02	9,545	795	2%	327.1

San Diego County Trauma Center Admissions
by Fiscal Year



Source: SDEMSA San Diego County Trauma System Report, SANDAG.



The following exhibit illustrates the incidence rate of trauma triage in other counties to trauma centers in California. Data were collected from local EMS agencies on “total number of patients triaged to a trauma center” for calendar year 2001. The incidence rate was then calculated using the 2001 population estimate for each county or region from the California Department of Finance. The population data used to calculate the incidence rates are for the resident population in the counties. Neither visitors nor undocumented immigrant populations are included in any of the population statistics and may have an impact on these calculations.

The regions with the highest trauma incidence rates were San Diego (321.2/100,000), Marin (318.6/100,000) and Contra Costa (290.6/100,000).

Comparisons between EMS regions are difficult due to regional variations in the data availability, the impact of temporary populations, and the use of the definition “triaged to trauma centers”. The chart does reflect an indication of considerable variation in triage rates by regions.

Future of Trauma

Looking to the future, trauma systems continue to be developed and improved throughout California and across the country. NHTSA's *Trauma System Agenda for the Future* envisions further integration of injury prevention, acute care and rehabilitation programs in order to achieve an understanding of all trauma care needs throughout the trauma care continuum and how they can be met. Continued research, improved technology, and applying what is already known are helping

make this goal possible. Federal funding for trauma systems continues to be a challenge as the overall Federal budget is adjusted for changes in the economy and other funding priorities. However, the

Exhibit 5 - California County Trauma System Comparison

California Trauma Incidence Rate (Per 100,000 Population)			
Local EMS Agency	Total Trauma Triage 2001	Population 2001	Incidence Rate/100,000 Population
San Diego	9,285	2,890,600	321.2
Marin	793	248,900	318.6
Contra Costa	2,839	977,000	290.6
Alameda	4,053	1,475,800	274.6
Santa Clara	4,472	1,706,400	262.1
Northern California ¹	1,533	604,100	253.8
Santa Barbara	1,003	405,700	247.2
Inland Counties (San Bernardino, Inyo, Mono)	4,144**	1,797,450	230.5
Riverside	3,459**	1,618,000	213.8
Sierra-Sacramento Valley ²	1,331	672,500	197.9
Los Angeles	18,837	9,748,500	193.2
Sacramento	2,345	1,267,800	185.0
Kern	1,200**	681,900	176.0
San Mateo	1,133	714,500	158.6
San Francisco	1,131**	789,600	143.2
Fresno, Kings, Madera	1,436	1,084,700	132.4
Coastal Valleys (Mendocino, Napa, Sonoma)	696**	684,000	101.8
Merced	218	216,400	100.7
Orange	2,659	2,910,000	91.4

¹ Northern California is comprised of Butte, Colusa, Glenn, Lassen, Modoc, Plumas, Shasta, Sierra, Siskiyou, Tehama & Trinity Counties; Sierra-Sacramento Valley is comprised of Nevada, Placer, Sutter, Yolo & Yuba Counties.

² The Inland Counties figure is for patients meeting trauma registry criteria only; the Kern County figure is approximate because theirs is a new system; in Coastal Valleys, an additional 617 patients met trauma triage criteria but were transported to a non-trauma center due to mitigating factors; the San Francisco figure consists of patients admitted to trauma and neurosurgery services, but not orthopedics or other specialties; the Riverside figure represents trauma activations at centers using different criteria until Jan 2002.

Source: Individual CA Local EMS Agencies, CA Department of Finance, The Abaris Group.

threat of terrorism has created renewed interest in a national trauma system network and may add additional momentum for system development.

There are emerging challenges for assuring a stable network of trauma centers in the country:

- Growing demand for services, coupled with diminishing capacity;
- Lack of adequate funding and compensation for emergency and trauma-related services;
- Shortages in available workforce; and
- Increases in the cost of liability insurance for hospitals and physicians.

Ongoing system development will require careful consideration and planning for mitigation of the effects of these trends.



II. Inventory of Resources

Overview

As part of the San Diego County Trauma System Assessment Study, The Abaris Group conducted numerous site visits to each trauma center and interviewed greater than 220 key stakeholders to obtain their input. A thorough review of historical reports and documents was also completed. Using these three avenues, The Abaris Group was able to inventory resources relevant to the trauma system in San Diego County.

Prehospital Care

Dispatch

Following a traumatic injury, access to medical care is most often achieved through calls to the Enhanced (E) 911 system, which is available throughout San Diego County. E-911 calls are delivered to one of 18 primary Public Safety Answering Points (PSAPs) or 16 secondary PSAPs. The PSAP dispatcher determines the need for police, fire or medical assistance. A review of all of the dispatch entities in San Diego's medical priority dispatch system was not part of the scope of this project, but interviewees reported that dispatch through the PSAP to the provider agency occurs seamlessly. *However, the number of agencies and the fact that they do not fit under the authority of the EMS Agency is one of the barriers to creating a linked PSAP-to-patient outcome database.*

The City of San Diego has the largest population and the most EMS responses in San Diego County. The City has dispatch centers with San Diego Fire and Rural Metro staff. Sophisticated CAD (computerized-aided dispatch) with AVL (automatic vehicle location) is used universally throughout the City. This CAD system is

being integrated into the portable computing documentation system San Diego Fire is using. San Diego City calls are divided into four categories based on the priority of response, which presents challenges in all advanced life support (ALS) response systems. Aggressive quality assurance (QA) on the required number of calls is performed monthly by San Diego City Dispatch. Issues about the quality of advice and appropriateness of the type of dispatch and unit are all appropriately evaluated. Dispatchers have expressed a need for more training and personnel.

Transporting Agencies

The San Diego County trauma system is supported by the following types of prehospital transporting agencies:

Exhibit 6 - San Diego County Transporting Agencies

San Diego County Trauma System	
Transporting Agencies	Count
Air Medical w/ Advanced Life Support	1
Advanced Life Support (ALS)	15
Basic Life Support (BLS) EMT-I	8
EMT-Defibrillation Agencies	40
Private Ambulance Providers	6

The 15 ALS providers provide service to the entire county and are supported by the 8 basic life support (BLS) providers. In addition, all fire departments (34 in the San Diego region) act as first responders.

Air-Medical System

The region has a single private provider of air medical services, Mercy Air, which provides two helicopters for the county and has backup capabilities in the region. These helicopters are located in strategic areas and provide timely response and comprehensive coverage to the region. Mercy Air flies approximately 1,500 flights per year within the region. Significant use occurs in the northern portions of the county due to long transport times. There is variation in use, as some jurisdictions in the north use



Mercy Air extensively for trauma transports while adjacent communities do not.

Mercy Air’s crew (approximately 80) are highly trained, with staffing configurations ranging from nurse with physician to nurse with paramedic and an on-scene time ranging from 15 to 20 minutes. Air medical protocols are a superset of the San Diego County EMS protocols and there is a rigorous quality assurance process.

Coordination between ground and air-medical crews is excellent. In most cases, ground units are well-versed in air-medical interfaces. Some of the more rural agencies require additional outreach to educate a volunteer workforce. Reception of air-medical crews by trauma staff has been universally excellent with adverse interaction occurring only on rare occasions.

Base Hospitals

In addition to the transporting agencies, base hospitals play a key role in the field triage of the trauma patient. Prehospital treatment and patient destination decisions are made through consultation with the base hospital physician or mobile intensive care nurse (MICN). In general,

Exhibit 7 - San Diego Co. Base Hospitals

San Diego County Trauma System
Base Hospitals
Grossmont Hospital - Sharp Healthcare
Palomar Medical Center
Scripps Memorial Hospital, Chula Vista
Scripps Memorial Hospital, La Jolla
Scripps Mercy Hospital and Medical Center
Sharp Memorial Hospital
Tri-City Medical Center
UCSD Medical Center - Hillcrest

base hospital radio contact for a potential trauma center patient is made to the trauma center destination (should the patient require trauma center care) to allow for continuity of care and communication. The exception is for suspected

pediatric trauma patients for whom radio calls are managed by Sharp Memorial Hospital. In addition, the base medical director and nurse coordinator monitor overall prehospital care, and are in turn monitored by the EMS Agency. Each base hospital has a committee that maintains communication with other hospitals in their catchment area and the assigned provider agencies. In addition, the Base Hospital Nurse Coordinators Committee is a countywide committee that meets to discuss the prehospital and base hospital care of patients and make recommendations to the EMS Agency. Similarly, the Base Hospital Physicians Committee makes recommendations to the EMS Agency and its medical director.

Through their frequent provision of on-line medical control, MICNs act as the backbone of the base hospital system. They confer with the EMS provider during transport and enter information into the County’s communication and information system, the QANet, which is immediately available to the receiving hospital. MICNs also provide audits of the system and examine compliance with protocols. MICNs have at least one year of emergency department experience, ambulance ride-along experience, and familiarity with QANet. Some are Trauma Nurse Core Course (TNCC) certified.

Communication

The county is covered by an coordinated 800 MHz system. This system is unified and provides consistent communication between all public safety members and hospitals including the rural areas of the county.

EMS Protocol Development

EMS protocol development in San Diego County is mature and involves most prehospital stakeholders. Countywide



“There is a prevalence of EMS systems in the country orienting to more “off line” medical control. “

protocols are in place and do much to enhance the integrity of the system. There are some differences in opinion between medical directors regarding some interventions.

There is a Protocol Task Force that is annually established by the County EMS Medical Director to review all treatment protocols for potential revision. As part of that task force, additional “treatments” have been added to the list of “standing orders” thus making a gradual move to “off-line” versus “on-line” medical control. The task force is also developing more evidenced-based prehospital protocols.

While there have been improvements, the current prehospital protocols remain predominately aligned to the “on-line” medical control model of EMS providers calling the base hospital for orders. There is a prevalence of EMS systems in the country orienting to more “off line” medical control.

Committees & Evaluation

San Diego County has approximately 18 trauma/EMS-related committees, some dealing directly with trauma and the remaining addressing trauma/EMS issues as appropriate. The primary trauma quality review committee is the Medical Audit Committee (MAC). However, the Prehospital Audit Committee (PAC) also participates in quality review of EMS components that affect the trauma system.

MAC is a critical component of the San Diego County trauma system. MAC audits patient care in the trauma system on a continuing basis. The committee was established at the inception of the trauma system and consists of representatives from all designated trauma centers as well as other facilities and key clinical groups (e.g. base hospital, orthopedic society, neurosurgical society, County Medical Examiner,

etc). MAC is operationally supported by EMS Agency staff. Cases are initially reviewed at the trauma center level and then forwarded through a formal Pre-MAC process for consideration for MAC review. Deaths are identified following review by the Medical Examiner. The autopsies and other Medical Examiner reports of all trauma-related deaths are sent to MAC participants for review. Cases that raise questions or are of significant educational interest are then forwarded to MAC through the Pre-MAC process. Additionally, the EMS Agency QA Specialist for Trauma reviews scene deaths and forwards cases that raise questions.

The County Paramedic Agency Committee (CPAC) includes representatives from each paramedic agency and is a forum for discussion of issues relating to prehospital care. The Prehospital Audit Committee (PAC) is a multidisciplinary committee composed of both prehospital and hospital representatives that reviews prehospital care. PAC has a member appointment to MAC to provide a linkage to the trauma system quality assurance process.

Another key committee is the Emergency Medical Care Committee (EMCC). The EMCC is responsible under state statute for monitoring ambulance operations and emergency medical care provided in the county. This committee is the primary advisory group to the EMS Agency and the Board of Supervisors on all aspects of EMS. The EMCC consists of 18 members, all appointed by the Board of Supervisors. Thirteen of the members are drawn from public service and safety agencies involved in EMS, and each of the five county Supervisors selects one additional public member to represent their district’s interests.

There are also numerous state and Federal committees active in San Diego that impact EMS and the trauma system in San Diego.



Exhibit 8 provides a list of committees, linked to or directly active in San Diego County.

ED Diversion

Like a majority of urban communities, ambulance diversion is a major concern in San Diego County. Diversion hours averaged approximately 4,224 hours per month for the 21 hospitals in the region during the period January 2001 through September 2002. This represents approximately 28 percent of the total monthly available hours. A major initiative was started in October 2002 that reduced diversion hours for the last three months of 2002 by 74 percent compared with the rest of the year. *This San Diego initiative has contributed significantly to the improvement of the pre-hospital and hospital systems and the patients that they serve.*

The ED diversion initiative is a collaborative process among the hospitals to allow patients to be transported by ambulance to their preferred hospital (except where prevented by the patient's medical condition) even if the hospital is on diversion. The first month of the initiative (October 2002) saw the most success, with 752 diversion hours that month (a 79 percent reduction from October 2001). Diversion hours for November (1,042) and December (1,443) rose from October's low, but were still significantly lower than the hours for those months in 2001 (3,275 and 3,592, respectively).

Trauma center bypass hours have been consistently low over the years. There is

one minor exception during this time-frame, when Palomar Memorial Hospital went on extended trauma bypass during the month of December 2001 (related to trauma physician contract issues). Trauma centers have been averaging 6 to 15 hours of trauma bypass per month, with the exception of Children's Hospital, which averaged less than one hour of trauma

Exhibit 8 - San Diego Co. Committees

San Diego County Trauma System	
Committees	
Federal/National	Metropolitan Medical Response System (MMRS) National Disaster Medical System (NDMS)
State	California Council of Local Health Officers (CCLHO) (EMS/Med Disaster) California Specialized Training Institute (CSTI) Advisory Board Emergency Medical Directors Association of California (EMDAC) EMS Administrators' Association of California (EMSAAC) EMS Commission Regional Disaster Committee
Regional	Region VI State Disaster Medical and Health Operations Coordinators
Local	Base Hospital Committees (at each base hospital) Base Hospital Nurse Coordinators Committee Base Hospital Physicians Committee (BSPC) Basic Life Support Operations Quality Improvement Task Force County Paramedic Agency Committee (CPAC) CSA 17 Advisory Board CSA 69 Advisory Board Emergency Medical Care Committee (EMCC) Emergency Nurses Association Fire Chiefs Association Hazardous Material Advisory Board Healthcare Association of San Diego and Imperial Counties Medical Audit Committee for Trauma (MAC) Metropolitan Medical Response System Prehospital Audit Committee (PAC) San Diego County Medical Society San Diego Terrorism Early Warning Group San Diego Terrorism Working Group

bypass per month during 2002. San Diego ED diversion hours for trauma centers vary in comparison to other EDs in San Diego County. Some have higher ED diversion hours and some lower than countywide averages.

Exhibits 9 and 10 provide a summary of ED diversion and trauma bypass hours for 2001 and 2002.

“This San Diego initiative has contributed significantly to the improvement of the prehospital and hospital systems and the patients that they serve.”



Exhibit 9 - San Diego Co. ED / Trauma Diversion Hours

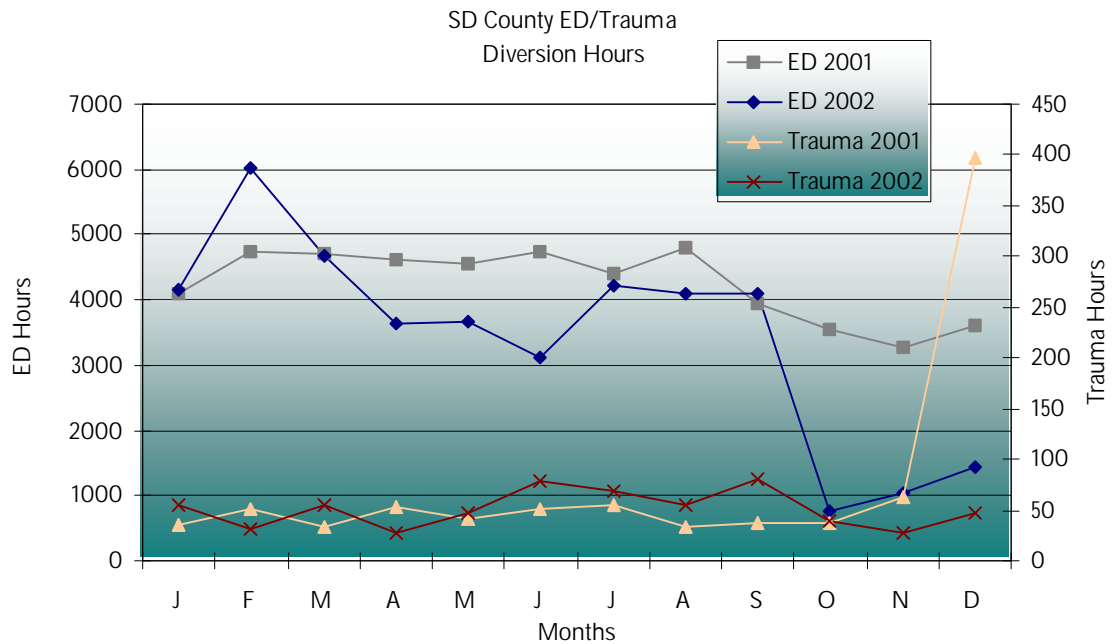


Exhibit 10 - Trauma Center Average Monthly Diversion Hours

Trauma Center Diversion/Bypass Hours - Average Per Month						
	Children's	Scripps Mercy	Palomar	Scripps La Jolla	Sharp Memorial	UCSD
Average Trauma Bypass Hours						
2001	2.7	6.4	42.7	5.6	9.2	7.2
2002	0.8	6.3	14.6	10.9	11.9	6.6
Average ED Diversion Hours						
2001	4.9	229.1	152.9	282.1	220.0	284.6
2002	1.8	183.3	109.4	226.5	167.5	220.7

Source: SDEMSA QANet, 1/01-12/02

Note: The average SD ED monthly diversion hours for 2002 was 162 hours/month

Information Systems

EMS providers are expected to complete a bubble form or directly enter data into the QANet for each EMS response. The County then scans these forms and merges that data with data from the QANet into a software analysis tool (SPSS). There is a considerable backlog of scanning. There are many reasons for this including the time lag from the event to receipt of the forms by the County, incomplete forms and the County's information system consultant has been unable to produce

programs necessary to complete the function in a timely manner. Some jurisdictions like the City of San Diego have developed their own redundant tracking and scanning systems. A major overhaul of the County's information system is underway at this time.

Special Studies

Throughout the existence of the trauma system, periodic studies and discussions of trauma protocols, triage standards and catchment areas have taken place within the trauma committee structure. Approximately two years ago there was considerable



“Obtaining stable on-call physician specialty coverage at trauma centers is an ongoing endeavor and will likely continue to challenge the trauma centers in the future.”

discussion about the catchment areas, particularly in the Mission Beach area, due to a desire by the City of San Diego Fire Department to establish definitions more closely fitting roadway and other geographic markers. This discussion at MAC was tabled due to a lack of impact data. During 1992, there was a trauma triage study (Erickson Study) that evaluated trauma triage and again in 2000 there was a workgroup on trauma triage that evaluated triage standards in comparison to the American College of Surgeons “Gold Book”, which had recently been published and is a source of national standards for trauma center systems. This latest study used methodologies to look at over- and under-triage but resulted in only modest changes to the San Diego County trauma triage standards however the changes that were made now more approximate that of the American College of Surgeons.

A recent trial study referred to as the “physician variation” study was conducted for three months during 2002 (March - May). This study allowed field personnel, in conjunction with the base hospital, to identify an injured patient who does not meet the trauma center patient criteria but felt to be of high risk to bypass a local emergency department (ED) for direct transport to an ED with a trauma center. The patients in the study were evaluated by a trauma center ED clinical team but not necessarily by the trauma clinical team. The purpose of the study was to determine if there were additional patients that would need a trauma center assessment even if they did not meet the direct trauma patient triage criteria. Of the 109 patients who qualified during the trial study, 10 (or 9 percent) were upgraded to full trauma activation after arrival to the trauma center’s ED. Six of those patients ultimately qualified for entry into the San Diego County Trauma Registry.

Trauma Centers

A detailed inventory by The Abaris Group at all six San Diego trauma centers resulted in identifying resources used for the trauma program. All six trauma centers met or exceeded the clinical standards for trauma center as promulgated by the County of San Diego EMS Agency. The clinical equipment and policy inventory completed by The Abaris Group demonstrated compliance with the standard of practice for trauma centers.

All six trauma centers exhibited complete call schedules for all of the required specialties. At various times there are difficulties with highly specialized physician coverage (e.g. hand surgery, ENT, etc) that appears to be based on the very limited availability of such specialists in the community. These cases are managed expeditiously by using alternative specialists or by transfer to another trauma center with that specialty’s coverage.

While there have been some historical gaps in coverage by on-call specialists at trauma centers (specifically Palomar), coverage is currently being met. *Obtaining stable on-call physician specialty coverage at trauma centers is an ongoing endeavor and will likely continue to challenge the trauma centers in the future.*

Three hospitals (Children’s, Scripps Mercy, and UCSD) have extensive teaching hospital commitments and resident involvement in trauma cases. Teaching hospital commitments include significant education efforts in the form of conferences, seminars and faculty-supervised quality assurance sessions.

Each trauma center has a designated trauma medical director. The trauma directors spend considerable amount of their time on the management of the trauma center. All six trauma centers have designated trauma nurse coordinators/program managers. For the last two years,



“This developing trend of using trauma center physicians for non-trauma center patients exerts additional pressure on the already fragile trauma center staffing for these specialties.”

the Palomar trauma program manager position was covered by the Director of Emergency and Trauma Services. The position has now been filled with a full time trauma program manager. Children’s trauma program manager in the past was allocated less than full time to trauma and there is a report that at least one other trauma program manager was functioning for a time in less than a full time capacity for the trauma center. The remaining trauma centers have always had full time program managers with 100 percent of their time on trauma center activities. *The lack of trauma program managers functioning in a that role in a full-time capacity has impacted some trauma centers’ performance.*

There are significant injury prevention programs at all six trauma centers and there is cooperation among the trauma centers on prevention and educational activities through the trauma center-sponsored Trauma Research and Education Foundation (TREF). Four hospitals (Children’s, Scripps Mercy, Sharp Memorial and UCSD) have extensive hospital-based trauma public education and prevention programs with designated funding and staffing.

Research is a system-wide commitment under the leadership of a comprehensive trauma research commitment at UCSD. The San Diego trauma system has contributed a large percentage of the sentinel published research articles on trauma systems throughout the country. The publication of trauma research continues, primarily in bench and clinical research areas. Each of the trauma centers and the County EMS Agency extensively participate in the Crash Injury Research and Engineering Network (CIREN) crash research study, which is investigating ways to re-engineer automobiles to reduce crash-related injuries.

Each hospital has an internal quality assurance process for trauma. While each trauma center uses different methodologies, they all follow the guidelines defined in the trauma quality assurance policies published collaboratively between the County and the trauma centers and cases requiring further review are forwarded to MAC for additional review.

Emergency Departments

There are 21 emergency departments (ED) in the county of which six include trauma centers. Some trauma cases appear to arrive at non-trauma centers (See Exhibit 54), but there are protocols and system expectations that the trauma patients be promptly transferred to a trauma center. There is reporting by the Base Hospital to the PAC on under triaged cases for arrivals to the Base Hospitals only.

There are indications that EDs in San Diego County are experiencing the same level of difficulty in obtaining subspecialist back up for their ED as the trauma centers. Some EDs will transfer patients with injuries that do not meet the triage criteria to the trauma center or a partner hospital (e.g. Scripps, Sharp) with varying degrees of success and speed. There were strong indications during this study that some non trauma center hospitals use the catchment zone trauma center as their ED’s safety net for difficult to obtain subspecialist coverage, commonly for neurosurgical and orthopedic coverage. *This developing trend of using trauma center physicians for non-trauma center patients exerts additional pressure on the already fragile trauma center staffing for these specialties.*



“The EMS Agency epidemiologist and surveillance staff are worthy of special note given their exceptional capability and contribution to the EMS and trauma system.”

System Leadership

Board of Supervisors

The original trauma studies were supported by the Board of Supervisors, and there has been continued support by the Board to develop and maintain a stable trauma system. Their creation of a leadership and data structure within the EMS Agency and their efforts in the ongoing process of prioritizing identified funds for the trauma centers are a clear indication of their commitment to the trauma system.

San Diego County EMS Agency

The trauma system is one component of the San Diego County EMS Agency's responsibilities. Within the EMS Agency, the EMS Chief is responsible for overall management, planning, coordination, monitoring and evaluation of the trauma system. The EMS Medical Director, who reports to the Chief, provides medical control, which includes development and approval of medical treatment protocols, continuous medical quality assurance and participation in agency research projects. The EMS Coordinator for Trauma, also reporting to the Chief, provides additional coordination and oversight of the trauma care system. The senior EMS Agency leadership staff have considerable experience and provide important role of neutrality and direction to the trauma system.

The EMS Agency has undertaken a number of strategic moves. In addition to this study, they are overhauling the QANet at considerable county expense. They are also completing the initial planning for a comprehensive EMS system review that would likely start some time in 2003.

The EMS Agency does not face the friction with private and public ambulance services

as is typical of other urban areas in the state. This has been attributed to the operating style of the EMS Agency, requiring accountability but delegating ambulance franchise authority to local communities.

The EMS Agency employs an EMS Coordinator and a Trauma Program QA Specialist who are responsible for coordinating all aspects of performance improvement and overseeing the trauma registry. Additionally, a Senior Epidemiologist and staff review and analyze data provided to the EMS Agency, supervise the trauma registry and prepare reports. Finally, there is support staff to assist with all other needs as directed.

The EMS Agency epidemiologist and surveillance staff are worthy of special note given their exceptional capability and contribution to the EMS and trauma system. Staff are assigned to the prehospital database, while others are assigned to support the grant-funded Safe Communities program. There are also staff assigned to the trauma registry and Medical Examiner database. Many of these positions are shared, but demonstrate the array and depth of capabilities of the EMS Agency. This resource also results in identification and early recognition of injury and medical chief complaints through the surveillance system. It is through this system that “leading cause” cases are identified and trends may be spotted. Even as such, reporting of trauma system trends and their use is limited in the current trauma system.

The San Diego County EMS Agency has substantial responsibility for trauma system oversight. There is an annual audit of trauma centers conducted by County staff that reviews trauma center capabilities against the trauma center standards. Every three years County staff coordinates a review of the trauma centers by the American College of Surgeons. Furthermore, the County coordinates the distribu-



tion of state funds to the trauma centers and traffic fine surcharges to all hospitals using formulas defined by the underlying authority of the parent statute. It is noted that the County has prioritized some of these funds for trauma center use. County staff coordinate the preparation of MAC materials and attend all MAC meetings.

The County also has responsibility for the management and oversight of the system's trauma registry. Annual reports are prepared regarding system demand and its characteristics. There are a number of other EMS Agency staff that participate in trauma system activities specific to their area of agency focus. For example, the prehospital and base hospital staff of the EMS Agency have participated in several special studies of the trauma system in which prehospital coordination was needed.

In addition, the EMS Agency maintains the QANet which is a real time, computerized wide area network that is used to collect and store patient information, hospital resource availability and to link EMS resources. The QANet allows providers terminal data entry at the provider site. This system, along with the scanning of prehospital bubble forms, allows the County to monitor EMS system activities and allows countywide prehospital analysis specific to trauma patients.

County staff provide another source of interface and continuity within the EMS system through their attendance at MAC meetings and other advisory committees throughout the county.

Trauma Center Leadership

As noted previously, each designated trauma center is led by a trauma medical director and trauma program manager. The trauma medical director is responsible for the medical direction of the trauma program, participation in Pre-MAC and MAC, trauma rounds, and other activities. The

trauma program manager is responsible for coordinating the trauma program, overseeing the trauma registry, and participating in the Pre-MAC and MAC process as well. The trauma program managers have additional duties that are specific to their individual trauma center configurations and priorities. Additional staff at the trauma center level includes trauma case managers, trauma registrars, trauma nurses, etc. Half of the trauma medical directors and trauma program managers in the San Diego County system have been trauma system participants in excess of ten years and the remainder have significant trauma, hospital and EMS experience.

Other System Components

Rehabilitation Facilities

Rehabilitation of trauma care has been seen as a critical resource for trauma patients to improve their functionality and quality of life. Trauma center rehabilitation is a fully integrated component of the San Diego trauma system approach to injury care and completes the trauma system concept in San Diego. San Diego County has five rehabilitation facilities for spinal cord and head injuries. These facilities have transfer agreements with the trauma centers. The rehabilitation facilities are:

Exhibit 11 – San Diego County

San Diego County Trauma System

Rehabilitation Facilities

Children's Hospital Rehabilitation Center
Palomar Hospital Rehabilitation Services
San Diego Rehabilitation Institute
Scripps-Encinitas Rehabilitation Services
Sharp Rehabilitation Services

Burn Care

Burn care is provided at UCSD Medical Center's Burn Center. This facility has transfer agreements with the trauma centers.



“The working definition of better or best practices was: ‘Trauma system components or activities that represent innovative or effective practices such that the trauma system is better served because of the component or activity.’”

Study of Best Practices

The Abaris Group conducted an inventory of better and best practices in trauma systems nationally. This was to provide a frame for reviewing San Diego County’s trauma system in perspective to other trauma systems’ practices throughout the country.

The best practice survey was conducted through telephone interviews. The 15 most largely-populated counties in the US were identified, along with any state with a historically acknowledged statewide trauma system. A sample of these communities was contacted. Trauma stakeholders in San Diego were also asked which communities outside of San Diego were best practice trauma systems. All of the communities identified were contacted.

The surveyed regions were:

- Contra Costa County, CA
- Los Angeles County, CA
- Orange County, CA
- Santa Clara County, CA
- State of Florida
- State of Maryland
- State of Oregon
- State of Washington

Other communities that were contacted but did not respond included Alameda County, CA, Dallas County, TX, Philadelphia County, PA, and the State of Arizona. Alameda County has a better practice funding source in the form of a trauma tax district that is fully described in the funding section of this report.

For purposes of this survey, a trauma system was defined as a system of trauma centers and their support components including prehospital, prevention, system monitoring and financing. Key leadership or stakeholders within each system were identified and interviewed. Using a formal script, the interviewees were asked to identify better or best practices using an outline of trauma

system components from the HRSA *Model Trauma System Plan*.

The working definition of better or best practices was: “trauma system components or activities that represent innovative or effective practices such that the trauma system is better served because of the component or activity”. The interviewees were told that to meet the test of best practice for this survey, the component or practice should be something an objective observer would report should be shared as a model for other communities. (For example, some communities might describe their trauma registry as being a best practice because of the extensiveness of the database, its use for looking at quality outcomes, the access it gives to trended data, and the role of the registry in creating system improvements.)

Interviewees were asked to rate on a scale of 1-5 (5 being best) their system’s level of achievement for each of the components of a trauma system and then to describe the characteristics of the components for which they had better or best practices. The examples below were provided by The Abaris Group for each component, although respondents were encouraged to provide other examples of their own. The interviewees were also asked if they had better or best practices not listed in the categories provided.

- Leadership Structure (Example: There is a leadership structure that provides system oversight, direction, trauma center support and the development of a trauma system plan meeting the core components of the Draft Model Trauma System Plan from HRSA)
- Triage System (Example: The trauma system uses defined standards that identify trauma patients at risk, assures their transport to trauma centers and are periodically reviewed to limit over-triage and assure minimal under-triage)



- EMS Provider Integration (Example: EMS providers are fully integrated into the trauma system through educational programs, collaborative policy development, quality review systems and participation in prevention programs)
- Definitive and Rehabilitation Care (Example: Trauma center(s) are designated through independent verification by a lead agency or the American College of Surgeons that hold to, or nearly to, the standards published by the American College of Surgeons; transfer systems that assure appropriate cases get transferred to a trauma center; state-of-the-art rehabilitation care)
- Information Systems (Example: There is a hospital-specific and system-wide databank that allows for review of demand, compliance and quality factors, using state of the art information technology, e.g., a Trauma Registry)
- Quality Review System (Example: A trauma system review process assures comprehensive trauma case review and trend analysis for optimized patient care at the patient, trauma center and system levels)
- Public Education/Outreach (Example: The trauma system has a formalized strategy for public education on injury prevention that is tied to the epidemiology of trauma cases and outreach to healthcare providers about access to the trauma system)
- Trauma Research (Example: There are clinical and empirical research commitments by the Level I trauma center(s) on one or more of the components of a trauma system)
- Legislation and System Financing (Example: The trauma system is supported by established legislative authorization, empowerment for monitoring

and a stable system for funding trauma centers and system activities that provides for appropriate resources to achieve trauma system goals)

Better or best practices in San Diego County were also categorized during the inventory and interview process.

This method for best practice inventory may have significant limitations. Definitions were suggested for each category and therefore might have led a community to a conclusion of best practice that might not have been previously considered as such. Also, information collected was self-reported and generally from one individual (considered a lead system stakeholder). Due to limited study resources, the respondents' opinions were not independently verified. Additionally, surveyed communities listed their better/best practices as such based on their individual expectations regarding what would qualify as a component for the "better" or "best" practice categories. San Diego's list of better/best practices is a composite of a number of stakeholder opinions and therefore faced a more rigorous test.

Results

Ultimately, eight trauma systems were surveyed and inventoried along with the San Diego Trauma System. Six surveyed communities identified their leadership structure as being best practice. The committee structures, multidisciplinary orientation and the nature of the county/state lead agency were all cited as examples of their best practices. All eight communities listed triage as either best or better practice. Key to most surveyed communities was the periodic updating of the criteria and standardization. Florida is presently reviewing over- and under-triage. There were two best and five better practices identified for the category of EMS provider integration. Most of these communities described prehospital staff involved in the policy setting and quality



review process. All eight communities described their definitive and rehabilitation care programs as best practice (5 communities) or better practice (3). Exceeding the American College of Surgeons criteria and credentialing rehabilitation programs were examples mentioned by several communities.

All surveyed communities listed information systems (IS) as a best (6) or better (2) practice. Key to the information systems component was a statewide or region-wide integrated registry provided by one software vendor. Washington State has a comprehensive EMS registry to allow trauma patient tracking from the field through definitive care. Quality review systems were rated by six regions as better/best practice. Subcommittee case review or regional reviews were listed by most. Santa Clara County is developing an outcome database that also does trending. Public education and outreach were listed by five locations. Washington State has eight regional coordinators assigned to this responsibility, which is in addition to each hospital's requirements in this area. Four regions listed the trauma research category as better/best practice, with other respondents stating that they were not knowledgeable about this component of their system. There are two Level Is in Santa Clara County with involvement in trauma research. Some of their surgeons, who are on sabbatical, use the time to complete additional trauma research.

Five regions rated their legislation and finance component as better/best practice. Two of these communities provide public funds to subsidize the trauma centers. The State of Washington has a stable statewide funding source for trauma centers through vehicle licensing and traffic fine surcharges. Five of the regions listed other better/best practices. Los Angeles County mentioned their efforts to reimburse private hospitals for uncompensated trauma care. Maryland noted their excellent working relationship between the state and the trauma centers

and their statewide communications system that allows inventorying of resources for diversion, etc. Oregon mentioned the excellent referral pattern between the Level III and IV trauma centers. Santa Clara County noted that they work especially hard to make the trauma registry relevant to the local providers and they issue an annual Trauma System Report. Washington noted their strong regional network that assures grass root support and buy-in on policies and planning. Both Oregon and Washington have an inclusive system, which includes statewide designation of hospitals at one of the levels. The exception for both states is their single metropolitan area (Seattle for Washington and Portland for Oregon) where the designation is exclusive to one or two hospitals, respectively.

These practices compare favorably to the San Diego County trauma system with its acknowledged best practices in leadership, definitive and rehabilitative care, quality review processes, public education and outreach, and trauma research.

The results of the best practice survey are further summarized in the exhibit on the following page.



B

Trauma System Best Practice Survey Better (✓) - Best (✓+) Practice <i>(self-reported by system stakeholders)</i>										
Community/State	Leadership Structure	Triage System	EMS Provider Integration	Definitive & Rehabilitation Care	Information System	Quality Review System	Public Education & Outreach	Trauma Research	Legislation & System Financing	Other
Contra Costa County, CA	✓+	✓	✓	✓	✓+	✓+	✓+		✓+	
Florida	✓	✓		✓	✓+		✓+			
Los Angeles County, CA	✓+	✓+	✓	✓+	✓	✓+		✓+		Compensation of private hospitals for indigent care
Maryland	✓+	✓+	✓+	✓+	✓+	✓	✓+	✓	✓	State communication system
Orange County, CA	✓+	✓+	✓	✓+	✓+	✓+	✓		✓+	
Oregon		✓	✓+	✓	✓					Strong referral patterns between IIIs and IVs
Santa Clara County, CA		✓	✓	✓+	✓+	✓+		✓+	✓	Annual system report
Washington	✓+	✓	✓	✓+	✓+	✓	✓+	✓+	✓+	Regional planning with local buy in
San Diego County, CA	✓+			✓+		✓+	✓+	✓+		

III. Special Topics

Trauma Triage

Introduction

The process used to select injured patients for transport to trauma centers, otherwise referred to as trauma triage, is a complex and diversified subject. There are in excess of 220 journal articles published on trauma triage methods and outcomes. The topic is made more difficult by the fact that while most trauma system triage policies include quantitative and qualitative decision making schemes, most contemporary trauma systems rely heavily on the qualitative field assessments of patients relative to the need for the trauma center.

The Abaris Group's analysis of trauma triage for the San Diego County trauma system used several approaches. First, factual knowledge was gained through a review of existing trauma triage documentation. This was supplemented with impressions established through interviews with system users. Together these formed the basis for The Abaris Group's review of the current status of trauma triage.

This review addressed trauma triage in the San Diego trauma system from three perspectives:

- catchment areas
- triage decision tools
- evaluation of capacity

An additional attempt was made to analyze trauma triage from trauma registry data and potential linkages with other databases. Major limitations were evident utilizing these resources to fully investigate trauma triage. Then, limitations in accessing data for quantitative analysis resulted in a focus on qualitative approaches for the analysis of the following topic areas:

- value of assessing over- and under-triage in a trauma system
- benchmarks in triage decision making
- barriers to analysis of trauma triage
- recommendations to enable analysis of system triage

Understanding the Triage Process

Catchment Areas

Catchment area boundaries define which trauma center a major trauma patient will likely be transported to within the San Diego trauma system. These boundaries exist today as they were defined in 1984 when the system began with only minor changes over the years. According to the collective historical memory of some senior trauma center individuals interviewed, the initial catchment area decision process was primarily driven by the EMS Agency and the trauma centers with input from the prehospital agencies. Boundary lines were said to have been drawn based on driving times to the trauma centers, the San Diego City Fire Department's Fire Demand Zones, and equity among the trauma centers. Traffic patterns and roadway access were also considered.

There is considerable debate by some prehospital agencies on the original zones and the level of objective care used to define the zones with a bias that the trauma centers had a strong role in their definition. *There has not been a significant review of trauma catchment areas since the beginning of the program.*

A San Diego County trauma system policy describes the catchment areas. There is a general boundary map and a multiple-page street-by-street description of the catchment area for each trauma center. Children (ages 0 - 14) with qualifying injuries or suspicion of risk are triaged to Children's Hospital regardless of the location of the incident. The maps and boundary descriptions are

"There has not been a significant review of trauma catchment areas since the beginning of the program."



“While a comprehensive review of triage occurred during this study, it did not deal distinctly with the issue of over triage.”

provided to paramedics in their training programs. A quick reference guide of the triage criteria is available, but it is rarely used. Most paramedics interviewed confirmed that the catchment boundaries were followed.

Triage Decision Tools

The San Diego County Trauma System has utilized a trauma decision tree algorithm to sort major trauma patients from other injured patients since implementing the county system in 1984. The trauma catchment decision scheme is a companion tool. According to trauma program managers interviewed, the algorithm had some minor updates in 2000 and was redistributed system-wide to make the triage standard compatible with the triage recommendations made in the revised American College of Surgeons (ACS) Optimal Resources document. The current algorithm is similar to the ACS’s decision tool. The San Diego tool includes pediatric physiological parameters and calls out the unique use of trauma hospitals as a decision point for classifying patients and major trauma. It sorts mechanism of injury into two categories. The algorithm directs taking the trauma patient to “[the] appropriate trauma center” as opposed to the closest or highest-level trauma center. While transport time to the trauma center is not directly addressed in the algorithm, it was addressed in developing the trauma catchment areas.

Studies

In September of 2001 a prehospital proposal from the City of San Diego requested a modification to the existing catchment areas due to a number of inconsistencies and complexities of following the catchment zone descriptions precisely and pragmatically. The proposal was presented to the San Diego Medical Audit Committee (MAC). An assumption of the proposal was that improved trauma center transport

decisions by the City of San Diego would result from modifying existing catchment areas to be more consistent with freeway access and major traffic flow. MAC requested the City provide prehospital impact data for one year to look at potential changes for the trauma centers. City EMS staff indicated that because of the lack of current and complete databases available to the City and the lack of compatibility of the databases (QANet, Trauma Registry), the City was not able to collect the data. The proposal has not been reintroduced.

There have been two studies on triage since program inception which were mentioned earlier in this report. The more recent study was in 2000, where a Trauma Triage Task Force was formed which included a trauma medical director, trauma nurse manager, pediatric trauma manager, base hospital nurse coordinator, base hospital medical director, two paramedics, the EMS Medical Director and County EMS staff. Many documents were reviewed by the task force, including the original current trauma triage policies, the previous triage guideline entitled *“Traumatic Injury Considerations for Emergency Personnel,”* the previous Erickson Triage Study and the American College of Surgeons Manual (Resources For Optimal Care of the Injured Patient 1999). Additional information utilized was statistical data related to trauma triage and trauma transfer from non-trauma centers to trauma centers for reasons of meeting major trauma criteria. A CIREN Crash Engineer also participated in the meetings, providing technical expertise on mechanism of injury and assessment of vehicle damage as it relates to injury. *While a comprehensive review of triage occurred during this study, it did not deal distinctly with the issue of over triage.*

Evaluation Capacity

Two approaches to identifying the current state of trauma triage evaluation capacity



were considered in The Abaris Group's review. They include the current use of the trauma decision algorithm and the current ability to track triage decision-making at decision points across the trauma care continuum. Data analysis was not possible as part of the investigation due to the lack of linked databases and the fact that the prehospital patient care report does not require or even provide space to indicate the reason for patients to be transported to a trauma center.

Trauma Decision Algorithm

The Trauma Decision Algorithm is used as a baseline to identify major trauma patients across the system. Prehospital providers utilize the tool for screening to identify major trauma patients and to determine the need to contact their trauma base hospitals for transport decisions. Mobile Intensive Care Nurses (MICNs) at trauma base hospitals make the final trauma center triage decisions based on the same Trauma Decision Tree Algorithm.

Both the algorithm and trauma catchment decision scheme are expected to be consistently utilized at multiple levels of the system (prehospital, trauma base hospital, trauma center, EMS Agency) for prospective or retrospective identification of major trauma patients. However, interviewed EMS provider agencies indicated that they rarely refer to either document directly. Most EMS providers indicated that they use their "experience" in determining trauma base hospital contact and in fact they tend to err in favor of sending the injured patient to the trauma center rather than a one-to-one match to the criteria. There is also a statement in the triage standard that states "When in doubt, take patient to appropriate trauma center."

The prehospital "experience" criteria method is particularly true for the "mechanism only" or "when in doubt" criteria. In addition, the criteria are considered by EMS field providers, and a majority of

other system stakeholders, as very permissive.

Prehospital staff reported variation among trauma base hospital staff in selecting patients for triage, *EMS field personnel expressed frustration regarding the fact that the base hospital staff (not the pre-hospital staff) make the triage decision and these decision makers may not be part of the trauma team and therefore not available to explain the reason for triage.*

Trauma centers activate various levels of trauma team response based on patients meeting the algorithm criteria. Some hospitals have customized criteria for trauma team or trauma consult activations. Children's Hospital, for example, has customized criteria used internally to meet the specific needs of injured children. There is some inconsistency among hospitals regarding trauma registry entries. Some trauma centers enter all trauma patients triaged to the trauma center and some enter only patients meeting the more limited County definition for major trauma.

Tracking Triage Decisions

A primary source for tracking trauma triage decisions is usually the prehospital patient care data collection form. Medical incident reporting in San Diego County for the prehospital side of the system includes both computer and paper reporting. QANet is computer-based and used by the majority of prehospital agencies. The City of San Diego does not use QANet but rather a paper bubble form that requires scanning. This is due to their belief that there are quality control problems with the system and the fact that it also is difficult to get reports from the system, and the reports provided are out of date. The City has initiated a redundant Pocket PC patient documentation system as well. San Diego City's call volume represents a major portion of the total EMS calls in the county.



“Finally, there are no fields in the trauma registry at either the prehospital or hospital levels that specifically identify what element or elements of the triage decision tree algorithm resulted in the triage decision made by medics, by the MICN for field triage, or by the trauma service for internal triage. “

While it is the MICNs responsibility to make the official triage decision, neither the bubble form nor the QANet have data fields that ask the medic to identify what triage criteria element was used to determine if the patient was a major trauma. Bubble form scanning for those agencies not using the QANet is reportedly 18 months behind at the EMS Agency, making investigation of the current triage practice very difficult.

The MICNs are the intermediary in the triage decision making process. They make the final decision for transport to a trauma center. All trauma medic reports are communicated through the MICN. The MICN utilizes the QANet to enter patient care information from the radio report. Physiological, anatomical, mechanism and other data is entered. As with medic reporting, the MICN does not identify the triage criteria used to classify the patient as a major trauma. Variation among MICNs and hospitals with regard to data input has not been established. Determining the appropriateness of the triage decision at prehospital, MICN, and trauma service decision points is therefore problematic. As mentioned, the actual reason for transporting a patient to a trauma center is not documented and there is no linked database to track decision to outcome. This makes evaluating the incremental impact of triage decisions impossible on a system-wide basis. Similarly, it makes determining where in the continuum the system can be improved difficult at best.

Trauma registries at the hospital and County levels do not include sufficient or consistently completed patient data from field care through discharge. *Finally, there are no fields in the trauma registry at either the prehospital or hospital levels that specifically identify what element or elements of the triage decision tree algorithm resulted in the triage decision made by medics, by the*

MICN for field triage, or by the trauma service for internal triage.

Value of Assessing Trauma Triage

Appropriate triage is a major factor in optimal patient outcomes as well as the optimal design and financial stability of a trauma system. The concept of triage is best described as the process by which the “right patient gets to the right hospital at the right time.” The goal of a contemporary trauma system is to limit over- and under-triage. Over-triage is generally defined as those patients that did not need the services of a trauma center, usually translated as those patients triaged to a trauma center but sent home from the ED. Under-triage includes high risk patients that are transported to a non-trauma center or that go unrecognized as a high risk patient at a trauma center. It is generally accepted in the literature that a level of over-triage must occur in order to capture those patients with less obvious, but potentially life-threatening, injury. A commonly quoted over-triage rate is 20 percent. There is however a collection of articles that argue that up to 35 percent over-triage is necessary to achieve as little as a 1 percent under-triage rate.

Using the ED discharge definition for “over triage”, there is considerable variation in the over-triage rate in San Diego trauma centers. San Diego trauma centers have over-triage rates ranging from 0 to 48 percent. The individual rate of trauma patients not admitted as inpatients for the six San Diego trauma centers (January 2002 to September 2002) were as follows (in percentage order): 0, 8, 21, 34, 43 and 48 percent. Most of the patients were discharged home from the ED while a small number of these patients died or were transferred.

The zero percent at one trauma center is as a result of a policy by that trauma center to “admit” all patients to their trauma



“A comprehensive study of the impact on outcomes and resource consumption of the triage criteria and the actual application of the criteria has not been conducted in the San Diego trauma system.”

service for at least an eight-hour period regardless of the outcome of the initial assessment. *This is an uncommon procedure and it is unclear whether their particular patient profile is different from other trauma centers as the arrivals by ambulance are all in theory dictated by the same triage standards countywide.*

It is difficult to compare data using this definition of “over triage” from individual trauma centers without more detail. For example, one hospital may admit a trauma patient for several hours and classifies the patient as an “ED discharge” and another that may “admit” a patient for the same number of hours and classify the patient as an “inpatient admission”.

Over-triage results in patients with only minor injuries being transported to higher level trauma centers rather than more appropriate facilities. It is understood that over-triage can overtax the trauma system, resulting in excessive resource use and potentially wasted trauma resources. Under-triage may create a situation where patients are put at risk by treatment at a facility not adequately equipped for trauma or where time is wasted in transferring these patients to a higher-level trauma facility.

Discussions with the San Diego trauma centers indicate a widespread belief that the trauma system has a clinically acceptable over-triage rate and is able to handle the resource needs of over-triage. Under-triage is believed to be minimal. There is a strong perception by the trauma centers that an in-depth quantitative analysis requiring changes in data sources is not needed. As has been previously described, there have been two studies of the triage system since system inception, but neither of these studies meet the rigorous test of a methodical triage review that is the standard for literature reporting. *A compre-*

hensive study of the impact on outcomes and resource consumption of the triage criteria and the actual application of the criteria has not been conducted in the San Diego trauma system.

The recent work and direction of the Physician Variation Study, described in the special studies section of this report, reinforces that the system is supportive of triaging additional patients directly to trauma centers. *However, the perception by most EMS providers and many non-trauma center stakeholders is that the over-triage problem is significant and in need of revision.*

Triage Benchmarks

A comprehensive quantitative analysis of system over- and/or under-triage enables an assessment of the efficacy of the triage criteria currently used and identification of specific issues relative to triage decision making, and may potentially be used to provide information useful for resource allocation decisions. There are a number of studies that provide benchmarks for triage analysis design.

Acceptable triage rates depend on the system goals and objectives as well as the impact on patient care and financial stability. Over-triage acceptance may be based on resource level and change with time.

Changes in triage criteria and their direct impact on those rates are evidenced in several studies investigating the role of mechanism of injury alone as the triage guideline. An example of using analysis to further improve triage standards is clearly defined in the 1986 Orange County (CA) study.²³ In that study, the initial rate of over-triage was reported at 18 percent. During a one-year period with only physiologic criteria used, 21 percent of the non-central nervous system motor vehicle

23 Baldwin, L. C., M. A. Murdock, and J. G. West. A Method for Evaluating Field Triage Criteria. JTrauma 26 (1986): L655-9.



trauma deaths occurred in non-designated hospitals. The criteria were modified to make them more sensitive (anatomical and mechanism criteria were added) and deaths fell to 4.4 percent, but the rate of over-triage nearly doubled to 40 percent. The study goes on to indicate that adjusting triage criteria must include an appropriate balance and system users must make that determination.

An Oregon study using injury mechanism alone as a triage criterion resulted in an over-triage rate of 14-43 percent depending on whether all patients or only those meeting clinical criteria were included in the computation. Using trauma score alone would have resulted in 8-36 percent of seriously injured patients being missed.²⁴ The study, which was limited by the number of patients (631) and the length of time (3-months), demonstrated the trade-off between over- and under-triage as triage criteria are changed.

It is important for trauma systems to ensure that the designated trauma centers continue to see a high volume of seriously injured patients.²⁵ Trauma systems were developed not only to provide treatment for the most seriously injured, but also for those with the “potential” for serious injury – the “mechanism of injury only” patients.

Quantitative analysis of triage can also provide documentation of financial factors impacting the trauma and EMS system. The financial impact on non-trauma facilities bypassed as a result of triage criteria for transport of seriously injured trauma patients to trauma centers is sometimes used as a reason for nonparticipation in a trauma system. One North Carolina triage study demonstrated that those seriously

injured patients treated in the rural facilities incurred increased LOS, hospital charges, and risk of dying as the injury severity level increased, but reimbursement changed little. The article encouraged the rural facilities to be full participants in the trauma system and support criteria that moved the seriously injured to the regional Trauma Center.²⁶

A common, and increasingly important, issue in trauma system participation involves uncompensated care. Insurance status may affect whether a trauma patient first seen in a non-trauma facility is subsequently transferred to a trauma facility. A similar analysis of triage and transfer practices in Washington State concluded that insurance status was indeed an independent predictor of transfer, with those patients having commercial insurance remaining in the initial admitting hospital.²⁷ These and other results of quantitative analysis may be used by the trauma system in supporting issues related to disproportionate reimbursement strategies.

Analysis of under-triage is critical because of the potential impact on patient care and outcomes. Not only is there a risk of increased mortality from under-triage, but also from complications and the resulting quality of life. A recent study in San Diego used data from four trauma centers and reported a rate of 10.1 percent in major in-hospital complications among trauma patients.²⁸ While the purpose of the study was to look at functional outcomes for these patients post-discharge, it can reasonably be argued that since these patients were treated in trauma centers following ACS guidelines and best practices, the rate of complica-

24 Lowe D K, Oh GR, Neely KW, Peterson CG. Evaluation of Injury Mechanism as a Criterion in Trauma Triage. *American Journal of Surgery* 152 (1): 6-10, 1986
25 Cooper, M, Yarbrough, D, Zone-Smith, L, Byrne, K, Norcross, D. Application of Field Triage Guidelines by Prehospital Personnel: Is Mechanism of Injury a Valid Guideline for Patient Triage? *Am Surg* 1995 Apr;61(4):363-7.

26 Rutledge R, Shaffer VD, Ridky J. Trauma Care Reimbursement in Rural Hospitals: Implications for Triage and Trauma System Design* *J of Trauma*, 40(6): 1002-8, 1996 June.

27 Nathens AB, Maier RV, Copass MK, Jurkovich GJ. Payer Status: The Unspoken Triage Criterion. *J of Trauma* 50(5): 776-83, 2001 May.

28 Holbrook TL, Hoyt DB, Anderson JP. The Impact of Major In-Hospital Complications on Functional Outcome and Quality of Life After Trauma. *J of Trauma*. 50(1): 91-95, 2001 Jan.



tions may be significantly higher for these patients if they were treated in non-trauma facilities. The study did conclude that major in-hospital complications contributed negatively to quality of life. Quality of life is seldom studied when triage criteria are evaluated.

Identifying those patients most at risk for over/under-triage may assist in the decision making process relative to a quantitative analysis for the San Diego trauma system. Using ACS criteria, literature indicates that most trauma patients at risk for under-triage are primarily older female patients and those less likely to have multisystem injuries. Rates of under-triage in the literature range from 20-30 percent (Oregon, 21.9 percent). Among those over-triaged, patients with head or face injury, intoxication, and obesity were over-represented. Reported over-triage rates are considerably higher than under-triage with most reporting over-triage rates of well over 25 percent.

Of note, the Los Angeles County EMS Agency conducted a comparison of the different triage criteria used throughout California. This exhibit can be found in Appendix E.

Barriers for Analysis

Several limitations related to triage analysis have been mentioned in this report. Additional investigation confirmed the difficulty in completing a quantitative analysis of triage in San Diego County. Specifically, these issues included:

(1) Patient Definition. There are significant limitations to the patient definitions used in current San Diego data sources (QANet, the Trauma Registry, and hospital discharge data). Cases included in the Trauma Registry are deaths, all transfers in or out, hospital

admissions greater than 24 hours, and admissions to an intermediate or intensive care unit. These do not include all of the patients meeting the trauma decision algorithm. The QANet provides information on all prehospital trauma transports. Hospital discharge data which could be used to look specifically at under-triage includes all patients admitted to the hospital but excludes ED treat and release cases and prehospital deaths.

(2) Linked Databases. There is no current ability to link data from dispatch through prehospital providers including the QANet to the limited data set included in the Trauma Registry and to other more inclusive trauma patient data sets (e.g. California Patient Discharge Dataset). Although the printed data dictionary information indicates that the QANet run number is included on both the QANet and Trauma Registry databases, it is apparently not currently used. There are plans to have an automatic download of prehospital data to the trauma registry.

(3) Triage Decision Points. The decision-making process at points along the continuum of care cannot be verified as no documentation of criteria used to make the triage decision is available. Timing of the availability of information from some of the data sources results in an inability to provide current data (e.g. the EMS Agency bubble form scanning is 18 months behind). The two trauma registry systems (Cales and Dales) cannot share data relative to outcomes. The ISS, RTS, and probability of survival are not saved when this information is transmitted for one of the registries. This situation is currently being addressed through other efforts.

29 Kilberg L, Clemmer TP, Clawson J, Woolley FR, Thomas F, Oreme JF Jr. "Effectiveness of implementing a Trauma Triage System on Outcome: A Prospective Evaluation, J of Trauma. 28(10): 1493-1498, 1988 Oct.



There are a variety of methods to conduct such a study in San Diego:

- (1) *Analysis of Triage to Outcome*. As early as 1988, Fresno County, CA used this approach in a study of triage guidelines with the objective of identifying the optimal combination of physiologic (using the Trauma Score), anatomic, and mechanism of injury criteria for correctly identifying the most critically injured patients without creating an unacceptable level of over-triage.²⁹ The study provided information prospectively on all patients transported by the EMS system as opposed to other studies which only looked at those transported to trauma facilities. In addition, they collected information on all patients, not just those admitted to a facility, and used multiple sources to obtain the most complete and accurate data possible. While the study had a relatively small number of patients, the results obtained provided not only information on balancing the over/under-triage population through specific guidelines, but more importantly provided a methodology for system-specific analysis in order to refine protocols relative to triage.³⁰

The major benefit of this approach is that it would allow an examination of prehospital events to evaluate if triage criteria are consistently followed, as well as the ability to measure both over- and under-triage (this would require that all calls go through QANet, not just those calls to a trauma base hospital). If it is possible only to link the data to the Trauma Registry then only over-triage could be analyzed since patients not entered into the Trauma Registry would be excluded or individual patients that went to non-trauma centers would not

be studied. If non trauma centers could be encouraged to participate in the study or the QANet data could be linked with the California Patient Discharge Dataset, then both over/under-triage could be analyzed.

- (2) *Retrospective Analysis of California Patient Discharge Data and Vital Statistics*. San Diego could use the California Patient Discharge Data set containing multiple IDC-9 codes to compute an ISS that could be used as the "gold standard" for calculating the sensitivity and specificity of the system. Calculations can be accomplished with commonly available software programs (ICD-Map). In taking this approach, consideration should be given to whether enough ICD-9 diagnostic codes are available to compute an ISS along with variables describing the patient and facility. This approach will be useful in obtaining a broad overview of both over- and under-triage. Using this method, over-triage can be calculated as has been done in other studies. Patients who were seen in the ED and admitted to the hospital possibly for co-morbid conditions will impact the resulting rate. Excluded from these calculations are those who were at risk for severe injury due to mechanism, but were evaluated by an expert (trauma surgeon) and determined to not have these injuries.

Limitations of the use of population-based data sources, primarily hospital discharge data and vital statistics death data, in assessing effectiveness of trauma triage have been documented to include:

- Incomplete data capture, for example, missing those cases treated and released without admission to the hospital, cases

30 Knopp R, Yanagi A, Kellsen G, Geldi A, Doehring L. Mechanism of Injury and Anatomic Injury as Criteria for Prehospital Trauma Triage, *A of Emerg Medicine* .17 (9): 55-62. 1988 Sep.



where death occurred after discharge but was primarily due to the trauma, and patients treated in federal facilities such as those on reservations or at military hospitals

- Coding issues relative to procedures and diagnoses when the data is designed for other purposes
- Lack of understanding of the data source on the part of investigators not familiar with the collection protocols and procedures as well as level of errors allowed. This limitation is not restricted to the California Patient Discharge Data sets.

Please refer to the additional discussion of population-based trauma study in the Data Analysis section of this report.

- (3) *Retrospective Analysis of Trauma Registry Data.* A number of studies have been completed using a retrospective trauma registry data review. One study involved investigating seriously injured patients who were first treated in rural hospitals. While not focused on triage guidelines per se, this study used registry data from Oregon and Washington to investigate the role of Level III, IV, and V designated trauma centers.³¹

The Florida Trauma Triage Study also used trauma registry data and published methods and results of their study including evaluations specifically focused on pediatric and geriatric trauma.³² This approach is often the most tempting because it represents more readily available and understood data. However, using registry data alone restricts the ability to explore issues of under-triage since patients never

triaged to a system facility, or those seen but not admitted for a period of time, are not included.

- (4) *Facility-Specific Analysis of ED Data.* This approach was discussed in a 2002 article that examined changes in triage guidelines relative to attending response in the ED as proposed by the ACS Committee on Trauma (ACSCOT). The 1999 guidelines, while limiting under-triage, result in potentially significant over-triage. The ACSCOT-amended guidelines for defining major trauma resuscitation are (1) confirmed SBP < 90 mm Hg at any time in adults, and age-specific hypotension in children, (2) respiratory compromise/obstruction and/or intubation, (3) GCS score <8 with mechanism attributed to trauma, (4) gunshot wounds to the abdomen, neck, or chest, (5) transfer patients from other hospitals receiving blood to maintain vital signs, and (6) emergency physician's discretion. While the results of this study were inconclusive regarding the role of trauma surgeon arrival time, they did substantiate the first four criteria as predictive of the most seriously injured patients whether measured by ISS, mortality rate, LOS, or higher number of ICU days.³³ This approach, if applied only to specified facilities, would not allow system-wide analysis, but could be adapted with individual facilities submitting only specified elements for analysis. This would be primarily useful for studies related to triage criteria efficacy.

31 Mullins, R J, Mann, N C, Hedges, J R, Wortall M H, Zechin, A D, Jurkovich, GJ. Adequacy of Hospital Discharge Status as a Measure of Outcome Among Injured Patients JAMA 1998;279:1727-1731.

32 Phillips S, Rond, P C III, Kelly, S M, Swartz PD. The Need for Pediatric-Trauma Specific Triage Criteria: Results from the Florida Trauma Triage Study, Pediatric Emergency Care. 12(6): 394-9, 1996 Dec.

Phillips S, Rond P C III, Kelly, S M, Swartz, P D. The Failure of Triage Criteria to Identify Geriatric Patients with Trauma: Results From the Florida Trauma Triage Study, J of Trauma. 40(2): 278-83, 1996 Feb.

33 Tinkoff G H, O'Connor R E. Validation of New Trauma Triage Rules for Trauma Attending Response to the Emergency Department, J of Trauma. 52 (6): 1153-1159, 2002 June.



Trauma Registry

Overview

An assessment was made of the San Diego trauma registry. Interviews were conducted with both of the proprietary owners of the two trauma registries utilized in the San Diego Trauma System. Dale Fortlage, with the firm Intelligent Software Solutions, implemented the original San Diego trauma registry 18 years ago. This registry's official name is The San Diego Trauma Registry but is commonly referred to (as it is in this report) as The Dales Registry. Rick Cales designed and implemented the registry known as TRAUMAI, approximately 19 years ago. The Cales Registry is new to the San Diego trauma system as of 2000. Two of the six trauma centers are currently utilizing the Cales Registry, Scripps Mercy and Children's Hospital.

Registry Specifics

Dales Registry operates in the DOS operating system and has approximately 20 standard reports. These reports are utilized predominately for the medical audit review process both within the trauma center and the system review at MAC. It has the capacity to generate additional reports but must be converted into software such as Excel or FoxPro in order to manipulate the data. If the facility has information system staff available, this is an easy task. If they do not, they can contract by the hour and Dale will generate the reports. Dale Fortlage indicated that he is probably called about a dozen times a year to support various trauma centers in generating special reports.

The Dales Registry is able to support some calculations, such as the probability of survival, and converting the abbreviated injury score (AIS) to an Injury Severity Score (ISS). It prints this information in a summary report used for MAC but the program

cannot write the results to a file. Thus, the calculations are not saved when the data are transmitted to the County. The EMS Agency is working on a program that will calculate and retain the ISS, RTS (revised trauma score), and the probability of survival from Dales Registry, based upon a program written by Cales. This will allow for the comparison of data from both registries to assess clinical outcomes.

Three of the four trauma centers that use Dales Registry transmit the data to the County by e-mail. Palomar Medical Center submits their registry data by disk. Both trauma centers utilizing the Cales Registry submit their trauma data monthly by disk. Approximately 250 data points can be collected by the trauma center with only 150 data points provided to the County. The other data is considered confidential and utilized as part of the peer review process at the individual trauma center. The list of complications is provided to the County but the internal review and corrective actions taken are not submitted.

There has been an expressed desire by some of the trauma centers using the Dales Registry to be able to link to the hospital mainframe. This would allow for the seamless transfer of financial data and basic demographic information, reducing their data input time by as much as 30 percent. The Dales Registry does not have plans to provide this linkage.

The Cales Registry operates in Windows and is built on a relational database as opposed to a flat file system. There are approximately 50 standard reports that can be generated by the trauma program manager at their facility. Additionally, they are able to query an endless amount of ad hoc reports whenever needed for special studies. Most reports have the capacity to be generated in both a narrative and graphic format. Cales has produced an identical summary report like the one used by all the trauma centers to complete the QA review for MAC. A comparison was



“While the County has fairly robust resources and an in-depth trauma information system, the direct or indirect limitations on data trending and reporting artificially confines the use of the resource potential.”

made of the data dictionary used in the Dales Registry and all data elements appear to be reconciled by Cales to create uniformity of the two programs.

Both registries will soon be an interface program where the data will be uploaded between the QANet and both registries and be used to upload the prehospital data into the trauma registries.

In 1999 there was an expressed desire on the part of the trauma program managers to evaluate other trauma registries. A “Registry Fair” was held, with vendors representing TRACS, Collector, Cales Trauma!, and the Dales Registry. The group did not make a unanimous decision. Some had concerns about moving to a Windows-based platform and possibly having limited access to past data that was in a DOS format. The trauma program manager at Scripps Mercy had prior experience working with Cales Registry and supported moving to the Windows format. They had a representative of their Information Services Department attend the vendor fair and they supported the decision by Scripps Mercy to change to the Cales Registry. Children’s Hospital also selected the Cales Registry. The two facilities started utilizing the new Windows-based registry in January 2000. The other four facilities remained on the DOS-based Dales registry. There was some interest expressed at the time to consider utilizing TRACS, which was developed by the ACS. However, it was not selected as it was in beta testing and needed more refinement.

Basically, the data is collected at the trauma centers and the County receives data with patients that meet global criteria and then the County screens the data that meets inclusion criteria. Not all hospitals provide their complete trauma registry data base to the County and there is a difference of opinion between the

trauma centers on the publication by the County of that data by individual hospital or for trending. *While the County has fairly robust resources and an in-depth trauma information system, the direct or indirect limitations on data reporting and trending artificially confines the use of the full resource potential.*

San Diego County Registry

Since January 2000, the EMS Agency has received trauma data from two different registries. They utilize the same criteria in defining the cases to be downloaded to the agency; all deaths, all transfers in or out, all hospital admissions greater than 24 hours, and all admissions to an intermediate or intensive care unit. Initially the EMS Agency had difficulty compiling the data into a single reporting structure and had to run parallel reporting methodologies. This caused a delay in generating their annual report. They have worked out a number of the conflicts that existed in comparing the two registries but it still takes a significant amount of County work and cost to make the data compatible. This is staff time that could be used for other initiatives for trauma and the EMS system. There clearly would be real time savings and cost benefit in having all providers using the same registry.

There are other significant delays with the County registry portion of the registry in terms of reporting results. There is a built-in delay of data sent from the trauma centers (3 month lag), significant time taken to rectify missing data, and the trauma centers have historically required the county to share data tables before reporting. *These built in inefficiencies add significant time delays to the County’s reporting functions.*



The County is planning on a quarterly abbreviated report which would reflect the previous quarter's activities.

Analysis of the San Diego Trauma Registry

The Abaris Group conducted interviews with the six San Diego trauma centers and the County EMS Agency staff. Based on these interviews and our expertise, the strengths, weaknesses and opportunities for the two programs were identified.

Strengths

Dales Registry

Dale's registry is a known commodity and has been in existence for approximately 18 years. The users are familiar with its operation and how to produce the standard reports they need for QA reporting. With the exception of County staff time, there is minimal cost as the product has been paid for and the only charge generated is when the user needs assistance in producing special reports. The existing registry contains approximately 20 standard reports. Moving the data into Excel or Fox Pro provides ad hoc or queried reports. It was expressed by some trauma program managers that they favor the Dales Registry because the current MAC review process has been built upon the reports generated by this registry. They believe it is a quality product and that because Dale is located in San Diego, he is able to service their needs and they are able to trend their data. The trauma program managers have voiced concerns about not being able to look at old data for trending if they move to a new Windows-based registry.

Cales Registry (Trauma!)

Cales Registry is written in Windows and has a relational database, which allows for

calculation and retention of the RTS, ISS, and the Probability of Survival. The program has the capabilities previously mentioned. Cales has produced a Summary Report like the one used by the Dales Registry for the MAC review process. He has also reconciled his data dictionary to match that of the Dales Registry.

The Cales Registry can be linked to other databases, making it possible to link to data collection systems within the trauma center. This allows for direct input of demographic and financial data into the registry, reducing the time it takes to enter a trauma case by thirty percent. It has the ability to link to the National Trauma Data Bank, allowing the individual trauma center to benchmark their performance against other trauma centers.

Technical support is provided by resource staff, located on the West Coast, and is available Monday through Friday during business hours.

Weaknesses

Dales Registry

The registry is written to work in the outdated DOS operating system, which has a number of limitations including its lack of ability to write calculations to an electronic file. The program can run calculations like the probability of survival, but it cannot save the output to an electronic file. The San Diego County EMS Agency is attempting to resolve this issue but this resolution will not deal with the multitude of other limitations of a DOS-based program.

The Dales Registry does not link easily with other databases and it only produces tabular data. Graphic reports can only be generated when data is exported into other



software. There are no plans to move the product into a Windows-based platform. A Windows-based platform would elevate many of the issues listed in this report.

Cales Registry

Cales' Windows version is a newer program and has a long history of new versions to improve functions, but which create additional learning needs. The technical support, although available, is not the same as the hands-on support received from the Dales Registry. As a new registry, there is the cost of purchase, training and maintenance, which do not occur with the existing Dales Registry.

Both Registries

Neither registry in the present format has the ability to make inquiries nor conduct trend analysis. There are also major limitations placed on the county relative to looking at system and center outcomes or complications even at the trended level.

Opportunities for Improvement

Most trauma program managers identified that there is an under-utilization of the data collected both at the facility and County levels.

Those using Dales Registry have difficulty creating ad-hoc reports unless they have knowledge of Excel or FoxPro to manipulate the data and create query structures. Those that did not have the knowledge felt they were probably under-utilizing the registry's capabilities. There was strong support from the users of Cales Registry that they could create any ad hoc report they wanted whenever they wanted, without needing direct support from the Cales technical staff.

There was an identified need to expect more reporting from the San Diego County EMS staff. Most trauma centers would like system reports from the County at the MAC

meetings. It would be beneficial to know if what they are seeing at their facility is a system-wide occurrence (e.g. a decrease in head injuries or increase in a specific injury, etc.). County staff would be willing to support this, if they received specific requests or clarification of expected reporting.

Improved Security

There is an opportunity to improve the security and handling of data submitted to the San Diego County EMS Agency. Most trauma program managers also felt there should be a sign off of receipt of the trauma data when provided on disk and for the Pre-MAC binder. This would create an accountability trail and validate their submission of the data. It was suggested that a reaffirmation by the San Diego County EMS Agency be written as to how and where the data are stored, who has access and how it is utilized.

Data from some trauma centers is still sent by e-mail to the County. The County questions the security of registry data submitted by e-mail. There should be some documentation of how this data is encrypted to prevent unwanted access.

Other Trauma Registries

Over the past two decades there have been at least 20 trauma registry vendors. Sophistication, user friendliness and vendor preferences have all permeated the decision process of selecting a trauma registry vendor. Interest in registry vendors has waxed and waned and many of the early vendors are no longer in business. The Abaris Group obtained information on current registries used around the country. Registries evaluated included:

- Trauma One by Lancet Technology – being used in LA County
- National TRACS by ACS – being used in North Carolina & Tennessee



Trauma Registry Comparison							
Trauma Registry Name:	Collector	Dales	Trauma!	Trauma Base	Trauma One	TRACS	Washington Trauma Registry
Features:							
Program Initiated	1989	1987	1986	1986	1987	1992	1986
Windows Based Platform	Y	N	Y	Y	Y	Y	Y
Relational Database	Y	Y	Y	Y	Y	Y	Y
Data Conversion From Previous System	Y	Y	Y	Y	Y	N	Y
Stand-alone or Network Functionality	Y	Stand Alone Only	Y	Y	Y	Y	Y
Supports Single Hospital, County or Statewide System	Y	Y ⁽¹⁾	Y	Y	Y	Y	Y
Number of Standardized Reports	25	20	50	65	75	50	25
Easy To Use, Customizable Reports	Y	Y ⁽²⁾	Y	Y	Y	Y	Y
Import Interface Capability	Y	Y ⁽²⁾	Y	Y	Y	Y	Y
Automated ICD-9 Coding, AIS90 and ISS scoring	Y	ISS Only	Y	Y	Y	Y	Y
Multiple Location Record Access	Y	Y	Y	Y	Y	Y	Y
Trend QI and Complications	Y	Y	Y	Y	Y	Y	Y
Training and Education	Y	Y	Y	Y	Y	Y	Y
Technical Support	Y	Y	Y	Y	Y	Y	Y
Data Entry by Internet or PDA	Y	N	N	Y	Y	N	Y
Generates Letter	Y	N	N	Y	Y	N	Y
Cost/Pricing⁽³⁾:							
Central Site (System)	\$ 6,000	None	\$ 30,000	Variable	\$ 7,000	\$ 3,000	\$ 6,000
Individual Hospital	\$ 5,000	\$ 2,500	\$ 7,500	\$ 6,000	\$ 5,000	\$ 2,000	Pd by EMS
Central Site Maintenance (annual charge)	\$ 2,500	No Charge	20%	\$ 1,500	\$ 5,000	\$ 2,500	\$ 2,500
Hospital Maintenance (annual charge)	\$ 2,000	No Charge	20%	\$ 1,500	\$ 1,200	\$ 1,500	Pd by EMS
(1) Dales Registry has a qualified "Yes" for these items as the system has the capacity to do the activity but it is either not well tested or utilized by all users of the registry.							
(2) Supports single hospital or County, but not statewide.							
(3) Pricing varies significantly for all vendors, depending upon how many hospitals are involved and level of product purchased.							

- Collector by Digital Innovations – being used in Pennsylvania
- Trauma Base by Clinical Data Management – being used in Ohio
- Washington State Trauma Registry

The following exhibit reflects the system capabilities for the registries evaluated which includes the Cales and Dales Registries. The pricing information is an estimate since there are many factors that go into a contract bid which provide for discounts based on the number of units purchased and features included with each product. There are clearly limitations to any software program. This exhibit of trauma registries suggests that some registries have additional functionality when compared to the two used in San Diego, but again this is location-sensitive. This analysis and the comparison table should provide some guidance in analyzing what alternatives are available from a performance and cost standpoint.

inception of their trauma system in the mid 1980s. Both Oregon and Washington State officials and others described in the best practice section of this report emphasized the importance of one integrated trauma registry software system.

Other Studies

It should be noted that the Washington State Trauma Registry recently converted their entire state to Collector. Until three years ago they had a number of registries utilized within their system. At that time, the state purchased the licenses to use Collector as their state registry. They provide the registry free of charge to all of their trauma facilities (85 hospitals) and they provide the training, doing a significant portion of the troubleshooting before a user can go directly to Collector to resolve an issue. They stated that no system was perfect but after much evaluation they felt Collector would best meet their needs. They have five levels of trauma centers including two clinics in rural areas. The decision to change registries required a huge commitment for training and education on the part of the state, but they believe it was well worth the effort.

The State of Oregon uses an in-house developed product and has since the



Injury Prevention

The Abaris Group undertook a study of injury prevention efforts in San Diego as a component of the study of the overall trauma system assessment. An inventory was conducted of the various injury prevention programs, identifying the epidemiology of injured patients seen at the trauma centers.

According to the Centers for Disease Control and Prevention, unintentional injuries are the fifth leading cause of death, exceeded only by heart disease, cancer, stroke, and chronic lower respiratory disease. Injury-related (fatal and nonfatal) visits to the emergency department (ED) increased 7.5 percent from 1999 to 2000, growing at a faster rate than all ED visits combined.

Unintentional injuries and deaths are ultimately avoidable, and there are a diverse number of injury prevention programs dedicated to reducing these occurrences. As prevention programs are implemented, there is an expectation that the number and severity of injuries will decline. A *Journal of Trauma* article published in January 2003 demonstrated that even dramatic improvement in clinical trauma care would only reduce trauma mortality by 13 percent. Yet over 50 percent of the deaths in the study were potentially preventable with pre-injury behavioral changes.³⁴ Another study demonstrated that while trauma centers and systems do reduce pediatric mortality, injury prevention has far greater potential impact on future pediatric injury outcomes³⁵.

The National Injury Committee for Injury Prevention and Control states: "Trauma care systems have been proven effective in reducing injury-related mortality and morbidity. They are an essential

component of a systematic approach to injury prevention from primary prevention through rehabilitation." (Injury Prevention: Meeting the Challenge, 1989).

There is ample evidence in San Diego of excellent support from the trauma centers, government agencies, private foundations and community organizations for injury prevention efforts/programs. Numerous injury prevention programs are directed by the trauma centers. There is also clear evidence of collaboration between the EMS Agency and the many organizations within the community focusing on injury control efforts.

San Diego EMS Agency & Prevention

The San Diego County EMS Agency has created an injury surveillance system. This data system has been in existence for seven years and is fully integrated into many injury prevention programs within San Diego County. This system consists of collating data from the prehospital data set, trauma center data set, the medical examiner's office, and law enforcement data. This injury surveillance system is able to provide timely data to organizations looking to identify the need for specific injury prevention programs or to evaluate their existing programs. The Agency also provides a stable source of baseline injury data to assist all injury prevention programs in the community. It is evident that the EMS Agency has developed strong collaborative relationships with organizations supporting and operating injury prevention programs. The EMS Agency defines their role in these collaborative relationships as follows:

34 R. M. Stewart, MD; J. G. Myers, MD; D. L. Dent, MD; P. Ermis, BA; G. A. Gray, MD; R. Villarreal, MD; O. Blow, MD, PhD; B. Woods, MD; M. McFarland, RN, MS; J. Garavaglia, MD; H.D. Root, MD; B. A. Pruitt Jr., MD. Seven Hundred Fifty-Three Consecutive Deaths in a Level I Trauma Center: The Argument for Injury Prevention. *J of Trauma*, Jan 2003; 54(1):66-71.

35 F. Hulka, MD. Pediatric Trauma Systems: Critical Distinctions. *J of Trauma*, Sep 1999 47:S85-9.



“One of the challenges at the EMS Agency level is meeting all of the demands of their core function (e.g. prehospital and trauma registry collection, assimilation and reporting) and responding to the various special requests and special studies the Agency conducts.”

- provide data for evaluation and/or injury prevention program implementation
- develop evaluation tools
- provide data for evaluation of program effectiveness

The County of San Diego has developed an exceptional staff commitment to the study of injury trends and injury prevention. The EMS Agency has staff members dedicated to or supportive of their injury control and epidemiology programs. One component of each staff member’s scope of responsibility is to provide data support to one subcommittee of Safe Kids, a local pediatric injury prevention collaborative, operating as a part of a national injury prevention initiative.

This injury surveillance system supports many injury prevention efforts within the community. A few of these programs are listed below:

- CIREN
- Community Health Improvement Partners, Violence Prevention Work Group
- Motorcycle Safety Foundation and other community based motorcycle groups
- Numerous suicide prevention programs
- Pacific Safety Council
- Safe Communities
- Safe Kids
- Safe Routes to School
- San Diego State University: evaluation of the data on adult and older adult injury

From 1997 to present, the EMS Agency has submitted an impressive 57 abstracts and/or poster presentations to the American Public Health Association, Association for Health Services Research, California Center for Childhood Injury Prevention, Emergency Medical Services-Children, and the Environmental Systems Research Institute. All abstracts are injury control/epidemiological based.

One of the challenges at the EMS Agency level is meeting all of the demands of their core function (e.g. prehospital and trauma registry collection, assimilation and reporting) and responding to the various special requests and special studies the Agency conducts. For example, the epidemiology staff has had a special interest in intentional injury and has reported and published a number of abstracts on that subject. However, much of the core work is strained as that special study work is accomplished. The prehospital data set is routinely behind by 18 months in terms of scanning and the annual prehospital and trauma registry report is not published any earlier than 18 months from the close of the year. While there are other factors that impinge on the Agency’s staff to produce their reports in a more timely fashion, it is not clear that, absent those limitations, the reports would be produced more expeditiously. It is also not clear who sets the priorities of the EMS Agency epidemiology staff and how well their priorities fit with the needs of the trauma system.

Inventory of Injury Prevention Programs

The inventory of injury prevention programs within San Diego County revealed a variety of programs offered through various agencies both public and private. Some of these programs have trauma center and or trauma system representation. Other programs represent local efforts of state and/or national programs. The San Diego County Trauma Registry/Injury Surveillance data has been a data source for some of these programs. There is no central coordination center or clearinghouse for injury prevention programs.

An inventory of trauma prevention programs by trauma center is as follows:



Children's Hospital and Health Center

Children's Hospital houses the Safe Kids Coalition. This is a 50-member collaborative of other injury prevention programs throughout the county. The program is managed by a highly enthusiastic person. They received a grant from the Robert Wood Johnson Foundation in the amount of \$265,928 for the period of 1-1-02 to 12-31-06. The grant title is Injury Free Coalition for Kids: Dissemination of a Model Injury Prevention Program for Children and Adolescents. Other prevention programs based at Children's Hospital include:

- Bike Helmet Distribution Program
- Booster Seat Hotline
- Car seat Safety Checks
- CIREN
- Drowning Prevention program: "Water Watcher" tags
- Multiple media events, and educational printed material distribution
- "Safe Walk to School" Program

Palomar Medical Center

Palomar has a very active injury prevention program. All trauma patients are entered into their trauma registry for injury prevention and surveillance purposes. A few of their prevention programs are:

- American Trauma Society's "Trauma-Roo" Program
- "Every 15 Minutes"
- CIREN
- Health Fairs

Scripps Memorial Hospital, La Jolla

Scripps La Jolla has a very active injury prevention program.

- Beach and Ocean Surf and Safety
- Blue Ribbon Campaign
- Child Passenger Safety
- CIREN

- Corrective Behavioral Institute Program
- "Every 15 Minutes"
- "La Pasada"
- "Red Light Running"
- San Diego Safe Communities 2000
- School Safety Program
- Various programs during Trauma Awareness Month
- "Vial of Life"
- Yellow Ribbon Campaign

Scripps Mercy Hospital

Scripps Mercy has a full time nurse budgeted for injury prevention and outreach. This staff person is very passionate about injury prevention. The trauma center has a policy to enter all patients into their trauma registry specifically for injury prevention analysis and surveillance.

Sample programs include:

- AARP Senior Driver Safety Program
- Arrestee Drug Abuse Monitoring Program (ADAM), Local Council
- California EMS Vision Implementation Project: Prevention and Public Education Committee
- Child Passenger Safety Educator Workshops
- CHIP: Violence & Injury Prevention Work Team
- CIREN
- Community Health Improvement Partners (CHIP): Suicide Prevention Committee
- "Every 15 Minutes"
- Methamphetamine Strike Force (MSF)
- Policy Panel on Youth Access to Alcohol
- Mid-City Safe Routes to School program
- National Depression Screening Day
- Reflections of Hope Project
- Policy Panel on Youth Access to Alcohol
- Senior High School Trauma Internship Program



- Safe Communities 2000
- San Diego County Substance Abuse Summit
- San Diego Safe Kids Coalition
- Screening and Brief Intervention Program
- Teen Trauma Center Tour/Presentation
- "The Drug Store"
- "Truth & Consequences: Your Teen and Drugs & Alcohol"
- Various public educational media events
- Yellow Ribbon Suicide Prevention Program
- Youthful Drinking and Driving Program

Sharp Memorial Hospital

There is one full-time position, an Injury Prevention Coordinator, under the auspices of the Sharp HealthCare's Community Outreach Division. This position is endowed and the staff person is very committed to injury prevention. There is peripheral but indirect collaboration with the Sharp Trauma Program. The scope of responsibility for the position is to coordinate injury prevention programs for the Sharp Health System.

Specific programs under this position include:

- "Think First" program for elementary, middle and high school children, and college students.
- Alternative School programs
- CIREN
- Injury and Violence prevention education at health fairs
- "No More on 54"

An outcome evaluation of the "Think First" program was undertaken and the results were published in a peer-reviewed journal. Children in grades 1, 2, and 3 were included in this study, and the results showed that following the implementation of this injury prevention program, the control group had increased their knowledge regarding injury prevention and high-risk behavior.

UCSD Medical Center

The injury prevention program at UCSD Medical Center is very extensive and there is full time staff support for their programs. Samples of their programs are:

- California Wellness Foundation (10-year grant)
- Car Seat Safety program
- CBI (Correctional Behavioral Institute)
- CIREN
- "Cops and Docs"
- Crime Prevention Project for Youth
- "Prom Night"

Trauma Research & Education Foundation (TREF)

Founded in 1983, TREF is a freestanding member organization supported by the trauma centers. TREF was originally created to provide a means for the trauma centers to work together for prevention, education and research. From the beginning, one focus/directive was injury prevention. The affiliation between TREF and the trauma centers of San Diego County is positive and supportive, and they have historically maintained an effective partnership. TREF's executive director is a dynamic and passionate advocate for the organization.

One existing valued role of TREF is to support the trauma nurse education system throughout the county, thus allowing the trauma centers to avoid duplicative costs. TREF also manages many projects on behalf of the San Diego County EMS Agency and the trauma system.

Support and focus for TREF has varied in recent years as the needed role of TREF, individual hospital commitment to the concept, leadership and the needs of the trauma centers have changed.



TREF, under new leadership, is undergoing a reinvigoration with targeted goals as follows:

- (1) Second Trauma - a curriculum development project with the American Trauma Society that focuses on effective and compassionate communication with the families of the injured. The curriculum will be trialed in San Diego County.
- (2) Terrorist Bombing Readiness Project – TREF will trial a trauma center-based review of mass casualty plans in an effort to teach the lessons learned around the world about casualty handling and the impact on healthcare services.
- (3) Binational Trauma Project – TREF will join with Baja California, Mexico trauma care professionals to create education projects for the nurses and paramedics of their region. They will also explore a pilot project to translate TRACS (ACS Trauma Registry) and TNCC into Spanish and introduce the registry and this curriculum to the Baja area.
- (4) Lifesaving Device – TREF will partner with a company which makes a new and promising life saving flotation device which has proven effective in pool and lakeshore rescues.
- (5) Prevention Programs – TREF will revisit old safety and prevention programs with a successful history. These include bicycle and pedestrian safety, beach and ocean safety and other projects.
- (6) Media Resource – TREF will become a more vocal and reliable media resource for injury and prevention activities.
- (7) Governance Structure – TREF will enlarge its board to include more community agency leaders - fire, police, schools, etc.

TREF's current and recent past injury prevention programs include:

- Health and safety fairs
- Helmet and bicycle safety programs
- "Ocean Currents"
- "Red Light Running"

- Seatbelt and restraint programs

Safe Kids Coalition, San Diego Chapter

The Safe Kids Coalition is a community collaborative program comprised of agency representatives and individuals united in their efforts to make San Diego County a safer place for children. Coalition activities range from conducting child safety seat check ups, to conducting drowning prevention campaigns and inspecting community playgrounds for hazards. It is housed at Children's Hospital and targets children aged 0 to 14. All trauma centers within San Diego County are members of the Safe Kids Coalition. The Safe Kids Coalition produces a report every two years called "Childhood Unintentional Injuries in San Diego County: A Report to the Community." The Safe Kids Coalition is also a member of the local advisory committee for the EMS for Children program.

Independent programs sponsored by the Safe Kids Coalition include:

- Child passenger safety program
- Gun lock distribution program
- Helmet distribution program

Other injury prevention organizations/ programs in San Diego include:

- American Academy of Pediatrics, California Chapter: Gun Safety Pilot Project
- California Emergency Nurses Association
- California Institute of Transportation Safety, San Diego
- Child Care Services
- Children's Safety Network (National Injury Data Technical Assistance Center), San Diego
- Community Health Education with Dr. Gerry Graf
- Crash Injury Research and Engineering Network (CIREN)
- El Cajon Fire Department (Safety Education)



- EPIC (Eliminate Preventable Injuries of Children)
- First Monday: Unite to End Gun Violence
- Injury Free Coalition for Kids
- Navy Environmental & Preventative Medicine Unit No. 5, San Diego
- Resources on Teen Violence, San Diego
- Safe Communities – a campaign to create community coalitions to reduce traffic crash injuries and deaths. They have pulled together existing programs/groups and have received 2 grants: one focused on the city, and the second focused on the county.
- San Diego City Attorney's Domestic Violence Unit
- San Diego County Health & Human Services Agency
- State & Territorial Injury Prevention Directors' Association
- The Center for Injury Prevention Policy and Practice (at San Diego State University Graduate School of Public Health)
- Think First
- UCSD School of Medicine Center for Youth Violence Prevention
- YMCA: Child Care Health Consultant Service
- EMS Agency Injury Surveillance Database (which accesses multiple databases)
- Hospital trauma registries
- Observed injury issues and/or identified need
- Prehospital database (QANet)
- Other sources deemed appropriate for injury control

Legislative Initiatives

SB69: a community partner's bill requires hospitals to provide evidence of doing community service to their area. The San Diego County EMS Agency assists the trauma centers with this process.

Observations

Direct funding and grant dollars for prevention activity between the trauma centers vary. For the most part, all six trauma centers have substantial commitments to trauma prevention as witnessed by their expenditures, number of programs and staff commitment. The San Diego County EMS Agency is also substantially involved with injury prevention. The County also relies heavily on grant money for injury prevention efforts.

There is strong commitment and a culture to support injury prevention from all trauma centers and the San Diego County EMS Agency. This commitment lends itself to an opportunity to collaborate in creative ways to meet the needs of the community and the organizations leading the various programs.

There is significant variation among the trauma centers regarding prevention targets. Most are matched to the mission of the hospital and to the hospital and trauma program needs and interests. The one central focus from all trauma centers is through TREF, but its prevention mission has been scaled back in recent years. The Safe Kids Coalition is the primary focus for most of the injury prevention programs. It

Target Populations

Through the use of the injury surveillance data system at the San Diego County EMS Agency, epidemiological injury control/injury prevention programs are matured and fully integrated into many collaborative community injury prevention programs. Trauma Centers are all fully engaged in injury prevention programs. Some of the trauma centers are actively involved in injury related research.

Data Sources

The data sources used by the trauma centers to tailor prevention programs include:



“Leveraging the work of other trauma centers and collaborating on trauma system epidemiology would assist in providing more cost effective trauma patient prevention initiatives.”

is not clear whether the Safe Kids Coalition, TREF or the individual trauma centers’ initiatives are based on the epidemiology of cases in the trauma system.

Because of the high level of dedication and the focus on specific sectors of injury prevention, a central source or clearing-house for all injury prevention programs would greatly assist with coordination, reducing duplicative programs and optimizing trauma center injury prevention resources.

One of the challenges of obtaining accurate and timely injury epidemiology data is that the data set submitted by each trauma center to the trauma registry varies according to the software. This may impact the quality of data available for true epidemiological based injury prevention efforts. If compatibility of the prehospital database and the trauma registry were possible, the resulting data could be used to more accurately target and address specific prevention programs.

Once the databases are coordinated, then opportunities for targeted trauma system prevention programs could be identified. One method to identify areas of weakness in the San Diego area is to use a matrix similar to what is used by the CDC to classify the types of injuries reported (i.e., rows represent mechanism (not blunt/penetrating), but motor vehicle, other transport, firearm, fall, etc. The columns represent the intent such as unintentional, intentionally inflicted by another, self-inflicted. Each project/program in the inventory could be entered in the appropriate cell. Apparently San Diego was one of the first EMS systems to adopt the methods. Data has been collected and trended since 1998 in this fashion. This matrix with injury rates should be published and used by the trauma centers to identify “gaps.” For example, in the cell labeled motor

vehicle injuries in children, the rate may be very low, but with multiple programs/projects, whereas falls in the elderly might only have one program. Not only could this identify gaps for the trauma centers and the system for future projects/programs, it could also show where there is a concentrated effort and where that injury has been reduced. Another consideration would be to include only those “cells” that are particularly applicable to trauma center patients as opposed to for injuries on the whole.

Stable funding is a problem for almost all injury prevention programs. When a facility or system is having financial difficulties, prevention is typically one of the first categories to get cut, as has been witnessed in San Diego. *Leveraging the work of other trauma centers and collaborating on trauma system epidemiology would assist in providing more cost effective trauma patient prevention initiatives.*

Trauma systems inherently need prevention programs as the work for the injured does not start with the care delivery system. As was stated by the National Committee for Injury Prevention and Control:

“Support for the development of comprehensive trauma care systems by all levels of government and by the health care and public health professions must be a priority. Trauma care systems have been proven effective in reducing injury-related mortality and morbidity. They are an essential component of a systematic approach to injury prevention from primary prevention through rehabilitation.” ³⁶

³⁶ “Injury Prevention: Meeting the Challenge”. The National Committee for Injury Prevention and Control, 1989, Oxford Press, New York, NY.



“It is clear that in San Diego the expectations for quality and quality monitoring of trauma care are very high.”

Trauma System Quality Improvement

Overview

Trauma system and trauma center quality improvement are critical features for assuring optimal outcomes for trauma patients. The level and extent of a trauma system's quality improvement process is dependant on the expectations of the system, the individual trauma centers and the public that they serve. *It is clear that in San Diego the expectations for quality and quality monitoring of trauma care are very high.*

In evaluating the trauma system's quality improvement program in San Diego County, The Abaris Group believes it is important to distinguish between quality care issues and quality system issues. The former tends to orient to patient care events and the latter to the performance and viability of the trauma system. Contemporary trauma systems should include system quality improvement initiatives that evaluate system operations, changing trauma epidemiology, market conditions and trends.

To conduct the quality improvement (QI) review of the San Diego trauma system, The Abaris Group conducted a meticulous examination of the trauma center and system quality improvement processes, methods and outcomes. This included a detailed review of key documents, policies and practices already in place for quality trauma review. Among items reviewed were trauma center survey reports and audits, MAC minutes for the past three years, quality assurance (QA) procedures and policies, and resource tools provided by the hospitals and the County. The Abaris Group also conducted side-by-side audits of

the hospital quality improvement process at each trauma center.

In addition, The Abaris Group extensively discussed the MAC process and its expectations and outcomes in interviews with a wide range of system stakeholders, reviewed all materials related to the process including Pre-MAC and MAC case binders, and observed two MAC meetings. The Abaris Group's independent and objective expert team conducted the review. This team included a trauma neurosurgeon, an EMS/ED physician, a pediatric trauma surgeon, a trauma surgeon, and a trauma system nurse manager.

San Diego Trauma Quality Review

In San Diego, quality review of the acute care portion of trauma care is an extremely high priority for the trauma centers and the system as a whole and is conducted both internally at each trauma center and system-wide. System-wide, quality review is conducted by the Medical Audit Committee (MAC). MAC is the countywide committee used to review actual clinical cases to determine potential for performance improvement. Pre-MAC is a screening process conducted to determine which cases are forwarded to MAC for review.

MAC Process

At each trauma center, cases are regularly reviewed at the trauma mortality and morbidity (M&M) committee. While each trauma center has a slightly different process for internal review, there is consistency among the trauma centers at determining how cases enter the MAC process. They conduct their individual reviews, conduct the preparatory work for the Pre-MAC (key representatives conduct the Pre-MAC review) and then participate in the MAC



meeting. This entire process, known as the “MAC Process” uses rigidly defined processes such that the level of review is consistent.³⁷

A number of MAC’s trauma medical directors and trauma program managers have participated on the committee since the programs early inception – providing a high level of institutional knowledge. MAC and Pre-MAC membership are presented in the tables below.

The MAC committee process underwent a scope change slightly greater than a year and now only completes patient quality review every other month with system policies and administrative matters dealt with in the alternative month. The CIREN crash reviews are alternated with the administrative reviews every quarter. The Pre-MAC process remains unchanged, and MAC works to get two months worth of cases handled at the bimonthly clinical meeting.

In addition, audits of each trauma center are conducted annually by the San Diego County EMS Agency and every three years through the American College of Surgeons’ Trauma Center Verification process.

When San Diego system stakeholders were asked about the strengths of the San Diego trauma system, the most frequent response was the MAC process itself particularly in terms of its integrity, vigorousness and the credibility

and confidence that it lends to the entire EMS system.

Cases are initially reviewed at the trauma center level (including review by each center’s trauma medical director) and then forwarded through a formal Pre-MAC process for consideration for MAC review. Deaths are identified following review by the Medical Examiner. The autopsies and other Medical Examiner reports of all trauma-related deaths for all hospitals are

Exhibit 14 - MAC Committee Membership

<i>MAC Committee Membership</i>
Trauma Center Medical Directors
Trauma Center Program Managers
County Medical Examiner
Trauma System Surgical Consultant
County Trauma System Coordinator
County Trauma Quality Assurance Specialist
Base Hospital Physician representing PAC
Neurosurgeon
Anesthesiologist
Orthopedic Surgeon
Emergency Medicine Physician from non-Trauma Center

Exhibit 15 - Pre-MAC Review Team Membership

<i>Pre-MAC Review Team Membership</i>
Two Co-Chairpersons of MAC
One Trauma Medical Director (rotating)
One Trauma Medical Director assigned to review non-trauma center deaths
The Emergency/Base Hospital Medical Director (PAC Representative)
An Emergency Non-Base Hospital/Non-Trauma Center Representative
The EMS Trauma Quality Assurance Specialist
The EMS Base Hospital Quality Assurance Specialist

sent to MAC participants for review. Cases raising questions are then forwarded to the MAC through the Pre-MAC process. Additionally, the San Diego County EMS Agency QA Specialist for Trauma reviews scene deaths and also forwards cases that raise questions.

³⁷ “Trauma Quality Assurance System”, County of San Diego, Health & Human Services Agency, Division of Emergency Medical Services, 2002.



“These significant variables limit the County relative to their practical and timely publication of relevant data.”

The goal of MAC is to assure consistent quality of care at the trauma centers and knowledge sharing between the representatives of each trauma center. Following MAC discussion, cases are brought back to quality review sessions at the individual trauma centers.

Data Access/Use

Trauma registry data is forwarded to the County and the County screens the data for inclusion criteria meeting the National Trauma Data Bank (NTDB) criteria. Over time there has been a rising concern over data security and use of the data outside very standardized reporting formats. For example, today the County is not permitted to publish trauma center-specific data in any manner, including raw volume. The complete data repository, part of the registry, is not permitted to be used, and this limits the County from doing off-line quality control or conducting trend analysis. There are also concerns about data integrity and confidence in the County's use of the data.

There are variables outside the County's control relative to the timely publication of data. These variables include the timing of data delivery, compliance with the completion of key data fields, variation of hospital inclusion criteria and the monitoring process of data publication that have been imposed by the trauma centers on the County. *These significant variables limit the County relative to their practical and timely publication of relevant data.*

Prehospital System

There are some gaps in prehospital coordination and an apparent disconnect between prehospital stakeholders and the trauma centers and MAC. As previously noted the MAC process does not have a significant role for prehospital stakeholders and yet prehospital issues were prevalent during The Abaris Group's observation sessions.

This gap varies by hospital and the issues are sometimes conflicting at some hospitals. EMS outreach may be strong at one hospital, but the same hospital may have communications problems with their prehospital caregivers. *By being more inclusive in considering issues of prehospital care, the MAC process and MAC leadership could lessen this disconnect which appears to be present.*

Observations

The demonstrated focus and strength of the MAC process is its sophisticated quality assurance model for clinical case management. The Abaris Group has the following additional observations regarding the quality review process:

- The Pre-MAC process is consistent among the hospitals. There is some variation among the hospitals in terms of which patients are included but all submit the minimum data set required by the County of San Diego, leading to the comparison of “apples with apples.”
- All centers, trauma directors and trauma program managers participate at a very high and credible level.
- The Pre-MAC process as outlined in the County procedures and articulated during interviews with the County and trauma center staff is complete and factual.
- Trauma surgeons, who are Pre-MAC reviewers, do an excellent job of identifying cases that warrant group discussion as cases of interest or care concerns. Both trauma centers and case reviewers take the process seriously.
- The Pre-MAC process results in identifying individual cases needing further review and there are above average quality review protections at each of the trauma centers.
- The cases selected for review are representative of the actual population of cases and there does not appear to be any bias or error in case selection.



- The MAC meetings observed were positive (non-confrontational but educational).
- Through review of the minutes and observation at meetings, there was strong surgeon lead discussion at the meetings. The Level I trauma center does not appear to dominate or overly influence the meetings.
- The cases are discussed in a manner which is constructive and directed to identification of correctable errors.
- Through the discussions, efforts are made to identify system errors, physician-related errors, and institutional errors which can be avoided in the future.
- Trauma surgeons from the trauma centers provide a frank and honest presentation of their cases and identify and disclose patient cases in which outcomes or elements of care were either unusual or problematic.
- Deaths are categorized as non-preventable, potentially preventable, or preventable. Regardless of the designation, a careful analysis is performed to permit improvements in patient care and outcome. Similarly, complications are carefully analyzed.
- Difficult cases are presented that allow discussion of new treatment or diagnostic modalities, and alternative but accepted treatment strategies.
- There is a flavor of “sport” involved in the interaction among trauma surgeons and in the presentation of hospital cases to the group which adds to the positive character of the review.
- During our review of the MAC minutes and observation sessions, prehospital issues were appropriately referred to the Prehospital Audit Committee (PAC).

There are many strengths to the MAC process, not the least of which are the in-depth case review and the educational and trauma clinical practice-modifying nature of the process. However, the Pre-MAC process is time consuming and excessive.

Almost all of the trauma program managers stated that they spend a significant amount of time preparing the Pre-MAC binder. There were some differences among the trauma centers in terms of the number of support staff for this process and whether they were full time or part time.

Despite a difference in perception among the trauma directors regarding the frequency of occurrence, the need to provide additional dictation about non-outlier cases occurs rarely. Based on The Abaris Group’s review, the range is from once or twice per year to once in ten years. When additional dictation is requested, it is usually not a QA issue but, rather something of educational merit, an interesting case, or the like.

Consideration of prehospital trauma issues is somewhat limited at MAC, based on a review of MAC minutes and some attendance issues. The participation of non surgeons is also minimal. The entire MAC meeting is structured to address QA issues at the physician level. The non physician participants supplement information included in reports and respond to specific questions at the meeting. There is little participation by the trauma program managers except for a report on their monthly meeting and an occasional comment.

San Diego County EMS Agency participation is extensive in terms of preparation and meeting attendance, although perhaps excessive in number of staff. This is apparently at the request of the trauma centers and the desire for this level of involvement is apparent at other meetings as well (e.g. Trauma Nurse Coordinators meeting). However, at the MAC meetings and during interviews, the EMS Agency staff demonstrated no significant role in the MAC process in spite of MAC’s billing as the vehicle for system QA. There is no data provided on the “system” and no real trauma system focus to the clinical MAC meetings or in any other forum that could



be determined.

While there has been some refinement over the years, the Pre-MAC and MAC process is essentially unchanged since the trauma system was initiated. The trauma centers strongly believe that the Pre-MAC and MAC process in its present format is necessary to maintain quality control and continue the educational benefits of the process.

“The San Diego Trauma System is on the cusp of making additional important contributions to trauma systems across the country through more trended use of the robust data warehouse that it maintains.”

The actual Pre-MAC process and how it leads to MAC is also very labor intensive. *The process is also event- and audit-based and as such does not address the trending, global care or process improvement needs that characterize a mature trauma system or deal with the multitude of strategic issues that the system will continue to face.*

There are some shortcomings in trauma system data collection and performance review processes which are not adequately addressed through a combination of the MAC and the trauma center review processes (annual and ACS). These are mostly trending, strategic and financial. Virtually all trauma directors and trauma program managers would like additional trended data from the County. This includes registry data reporting on the trends and outcomes of different injuries (e.g. injuries on the rise or decline, etc.). There is real interest among trauma directors and program managers to be able to compare their results with the other centers and with the system as a whole. Lastly, there is vast data on systems operations at multiple levels which lends itself to research and reporting on process, outcomes and system design. *The San Diego Trauma System is on the cusp of making additional important contributions to trauma systems across the country through more trended use of the robust data warehouse that it maintains.*



IV. Data Analysis

Overview

Data for this study were drawn from both public and proprietary sources. The County of San Diego defined data sets to be collected as part of the study that included overall hospital demand, cost and revenue data, and trauma-specific data. The Abaris Group added to the data collection process additional data that would assist The Abaris Group in completing its analysis of the trauma system.

During the trauma center site visits, clinical and financial data were collected regarding hospital-wide, ED, and trauma services.

Supplemental data were collected from the Office of State-wide Health Planning and Development, Medicare Cost Reports, the San Diego County EMS Agency's Trauma Registry and the QANet, and the recently-completed study by Phoenix Healthcare Consulting. The Abaris Group also collected population-based data from SANDAG.

Agreement was reached between the County of San Diego and the trauma centers that publicly available data could be disclosed in the report to the degree that it was from public sources but proprietary data would only be used in a summarized fashion. The Abaris Group also agreed to review a previously completed trauma cost and revenue study (Phoenix Healthcare Consulting) and to the extent needed, use portions of that study as the basis for the cost and revenue portions of this study.

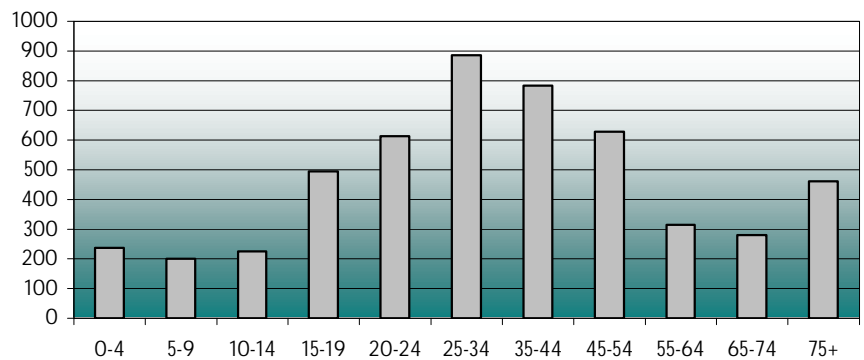
Trauma Patient Demographic Profile

The Abaris Group conducted an overview of trauma center patient demographics using the data from the San Diego County EMS Agency's Trauma Registry for 2001 and the Prehospital Database for FY 2000.

The data, as summarized on the following exhibits, demonstrates that the most frequent age group for trauma was 25-35 years of age. In 2001, the most common race/ethnicity was White (55 percent), followed by Hispanic (29 percent). Males accounted for 70 percent of the cases and females 30 percent.

Exhibit 16 - San Diego County Trauma by

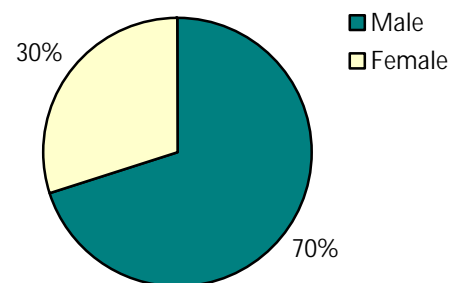
San Diego County Trauma by Age Cohort, 2001



Source: SDEMSA Trauma Registry, n = 5,123.

Exhibit 17 - San Diego Trauma by Sex

San Diego County Trauma by Sex, 2001



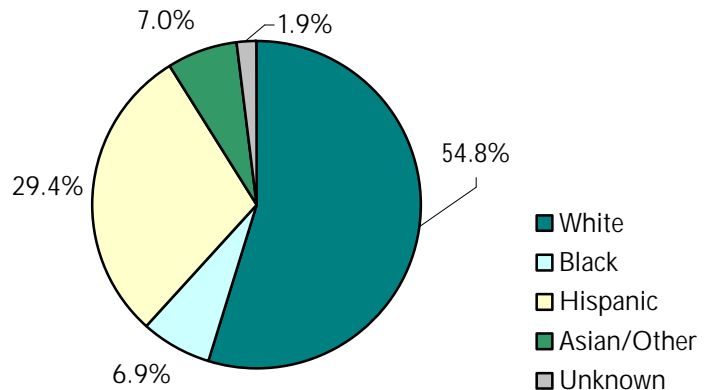
Source: SDEMSA Trauma Registry, n = 5,120.



As part of the survey of trauma center patients, The Abaris Group used San Diego's Trauma Registry CY 2001 to list the frequency of diagnoses and surgical procedures (multiple diagnoses are reported for individual patients). The most frequent diagnoses were open head wounds and concussions fractures. The most frequent surgical procedures are also listed in Exhibit 20 (reporting hospitals only).

Exhibit 18 - San Diego Trauma by Race/Ethnicity

San Diego County Trauma by Race/Ethnicity, 2001



Source: SDEMSA Trauma Registry, n = 5,120.

Exhibit 19 - Most Frequent Diagnoses of Trauma Patients

San Diego County Trauma System Top 20 Diagnoses, 2001

Description	Percent of	
	Cases	Total
Other Open Wound Of Head	1,449	7.5%
Concussion	1,066	5.5%
Fracture Of Face Bones	856	4.4%
Fracture Of Rib(S), Sternum, Larynx, And Trachea	755	3.9%
Fracture Of Vertebral Column Without Mention Of Spinal Cord Injury	720	3.7%
Subarachnoid, Subdural, And Extradural Hemorrhage, Following Injury	717	3.7%
Contusion Of Trunk	676	3.5%
Sprains And Strains Of Other And Unspecified Parts Of Back	601	3.1%
Superficial Injury Of Face, Neck, And Scalp Except Eye	558	2.9%
Contusion Of Face, Scalp, And Neck Except Eye(S)	540	2.8%
Intracranial Injury Of Other And Unspecified Nature	468	2.4%
Fracture Of Tibia And Fibula	456	2.3%
Cerebral Laceration And Contusion	455	2.3%
Fracture Of Pelvis	437	2.2%
Fracture Of Radius And Ulna	397	2.0%
Superficial Injury Of Hip, Thigh, Leg, And Ankle	388	2.0%
Traumatic Pneumothorax And Hemothorax	360	1.9%
Contusion Of Lower Limb And Of Other And Unspecified Sites	330	1.7%
Injury To Heart And Lung	324	1.7%
Fracture Of Base Of Skull	305	1.6%
Other	7,575	39.0%
Total	19,433	100.0%

Source: SDEMSA Trauma Registry

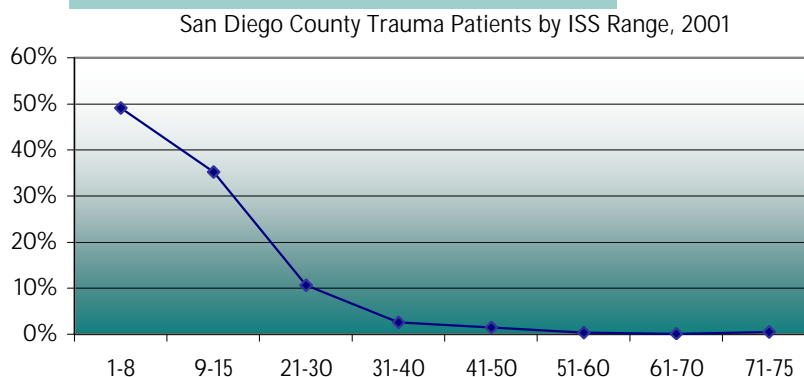


Exhibit 20 - Frequent. Trauma Surgical Procedures

San Diego County Trauma System Top 20 Trauma Surgical Procedures, 2001		
Procedure	Cases	Percent of Total
Exc Debrid Wound-Infec/Burn	490	6.1%
Sut Skin & Subq Tiss-Oth Sites	364	4.5%
Nonexcisional Debrid Wound-Infec/Burn	305	3.8%
Op Reduc Fx W/Int Fix-Tibia & Fib	263	3.3%
Explor Laparotomy	245	3.1%
Op Reduc Fx W/Int Fix-Fem	219	2.7%
Oth Wound Irrig	200	2.5%
Op Reduc Fx W/Int Fix-Oth Bone	135	1.7%
Applic Splint	123	1.5%
Op Reduc Fx W/Int Fix-Radius & Ulna	116	1.4%
Temp Tracheostomy	115	1.4%
Debrid Op Fx-Tibia & Fib	112	1.4%
Applic Oth Cast	111	1.4%
Oth Repr & Recon Skin & Subq Tiss	93	1.2%
Insrt Intercostal Drain Cath	87	1.1%
Op Reduc Mandib Fx	80	1.0%
Oth Skin Gft Oth Sites	74	0.9%
Oth Craniotomy	73	0.9%
Op Reduc Fx W/Int Fix-Humerus	69	0.9%
Venous Cath-Nec	63	0.8%
Other	4,670	58.3%
Total	8,007	100.0%
Source: SDEMSA Trauma Registry		

The Abaris Group also reviewed the distribution of Injury Severity Scores (ISS). The following chart shows that about half of all trauma patients have an ISS score in the group 1 to 8, while 35 percent of trauma patients had an ISS of 9 to 15. Only 5 percent of San Diego County trauma patients had scores greater than 31.

Exhibit 21 - Trauma Patients by ISS Distribution



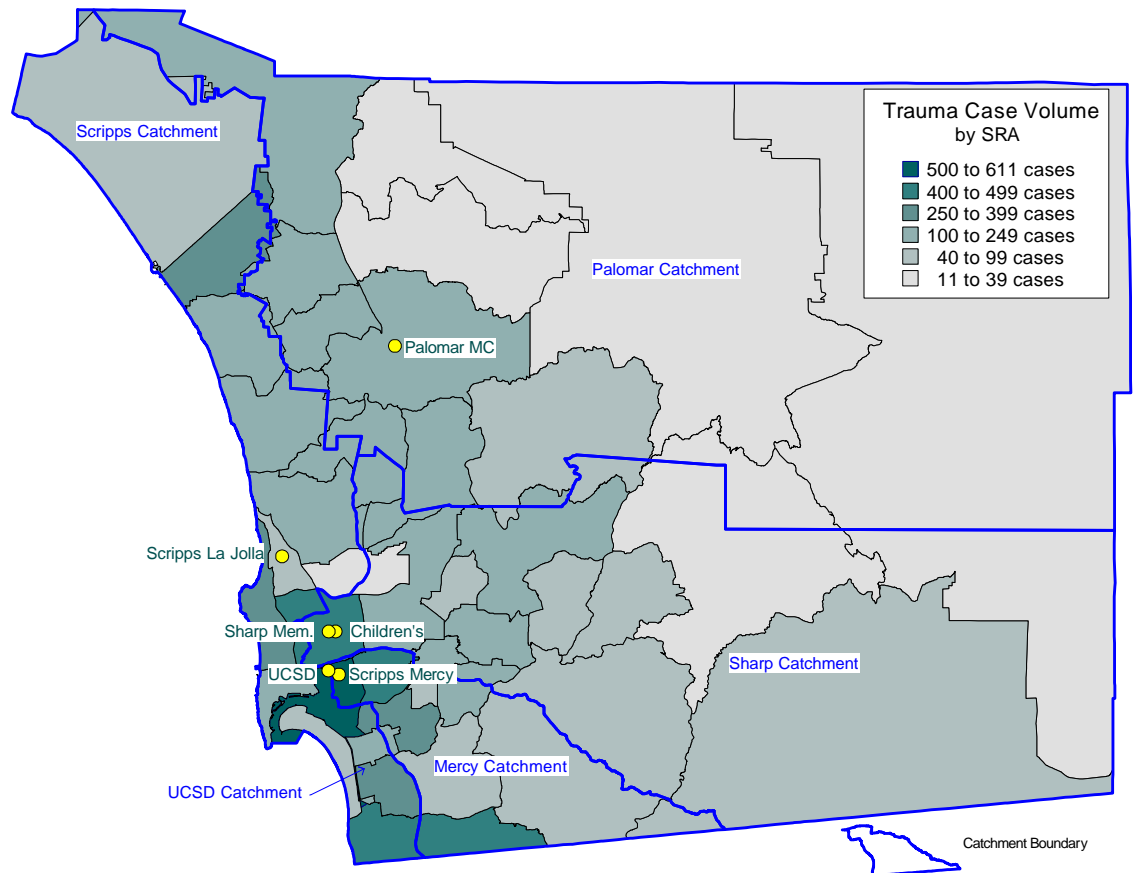
Source: SDEMSA Trauma Registry, n = 4,566

The Abaris Group also used the San Diego County EMS Agency Prehospital Dataset for FY 2000. This data base has additional data points and there are geographic identifiers which allows for mapping capability. These are EMS transports only and do not reflect the total trauma volume. There were 6,445 trauma transports for FY00 of which 6,113 records had identifiable subregional areas (SRAs) for mapping.



This following map illustrates the volume of trauma cases by sub regional area (SRA). The SRAs with the highest volume of trauma cases are those around the cluster of four trauma centers (Sharp, Children's, UCSD and Scripps Mercy), except for one SRA along the western portion of the Mexican border.

Exhibit 22 - Trauma Volume by SRA

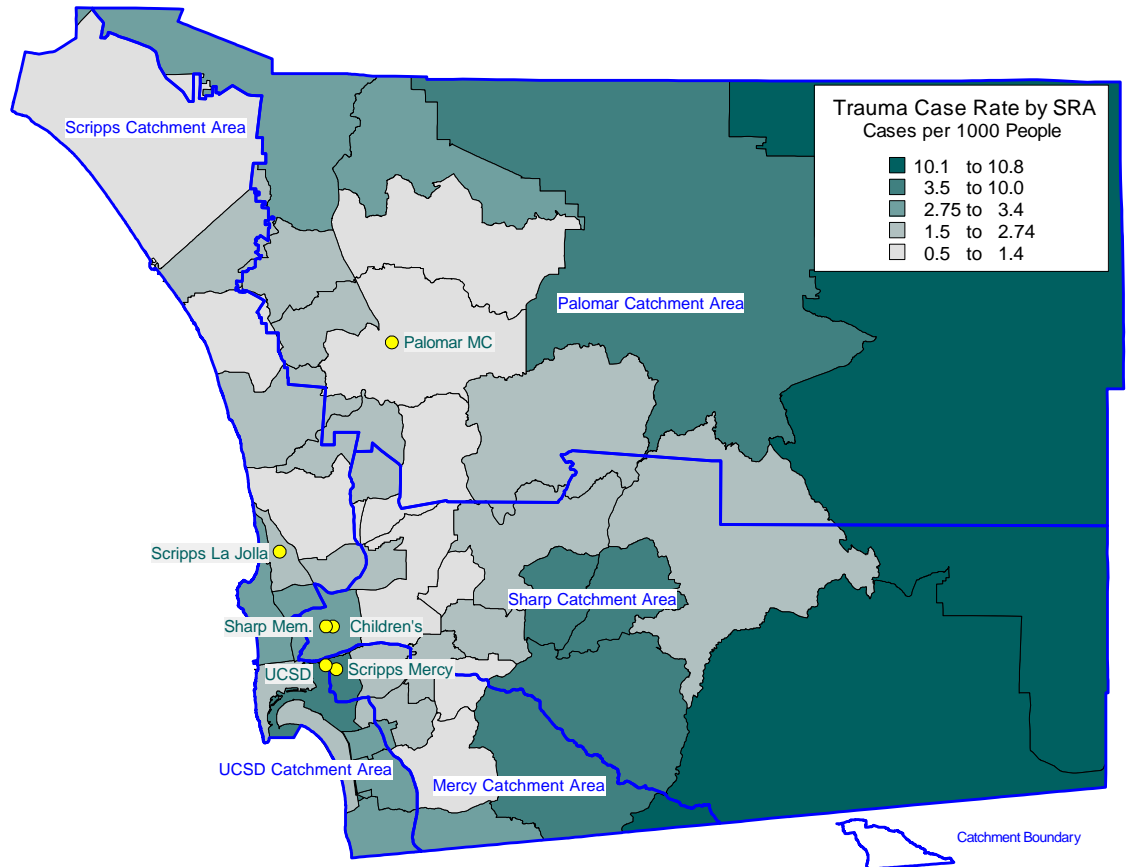


Source: SDEMSA Prehospital Dataset FY2000, n = 6,113



This map depicts the trauma case rate per 1,000 population. The case rate is high for the two SRAs in the east because they have very little population and any increase in trauma injuries will result in dramatically higher case rate³⁸. There are five SRAs with rates between 3.5 to 10 traumas per 1,000 people.

Exhibit 23 - Trauma Utilization Rate per 1,000 People by SRA



Source: SDEMSA Prehospital Dataset FY2000, n = 6,113

³⁸ They have major roadways (Interstate 8, etc.) which bisect their entire east – west width, undoubtedly adding to their overall trauma numbers. In other words, they have a very low resident population but probably a relatively high transient population. Thus, their trauma rate is more reflective of the transient population (motor vehicle crashes and related) than the trauma from the resident population. Any increase in trauma numbers will reflect dramatically in their rate, due to their low resident population denominator, as opposed to the SRAs with high population numbers, which will require a major shift in their trauma number to have a substantial impact on their rate.



Motor vehicle crashes (MVCs) are a major source of traumatic injury – they accounted for almost 53 percent of all trauma cases. The second most frequent injury is falls (15.8 percent).

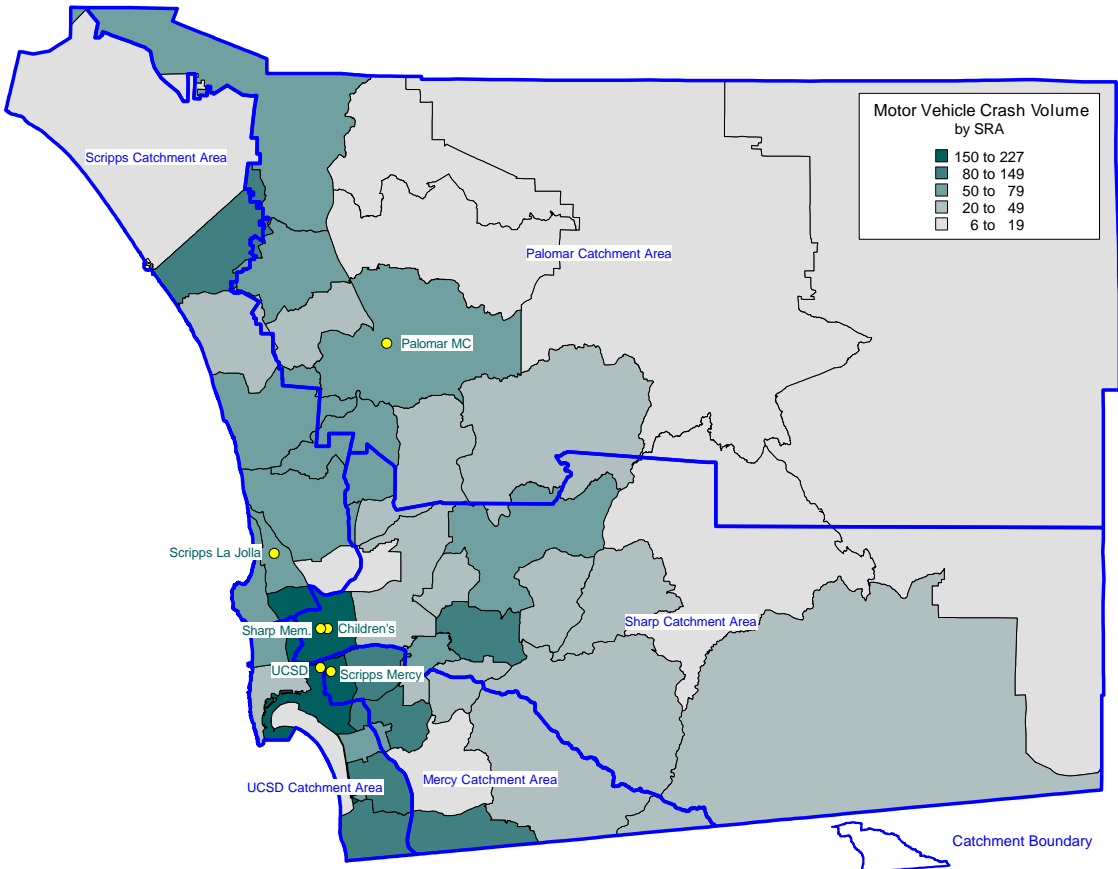
Exhibit 24 – Causes of Traumatic Injury

San Diego County Trauma System Cause of Injury, FY 2000		
Cause	Total Cases	Percent of Total
Motor Vehicle Related	3,386	52.5%
Falls	1,020	15.8%
Blunt Trauma	326	5.1%
Cut-Pierce	321	5.0%
Firearms	165	2.6%
Pedalcycles	152	2.4%
Other	1,075	16.7%
Total	6,445	100.0%

Source: SDEMSA Prehospital Dataset, FY 2000, n = 6,445

The following map illustrates the MVCs by SRA. The SRAs with the greatest number of motor vehicle crashes are in the Scripps La Jolla, Sharp, UCSD and Scripps Mercy catchment areas.

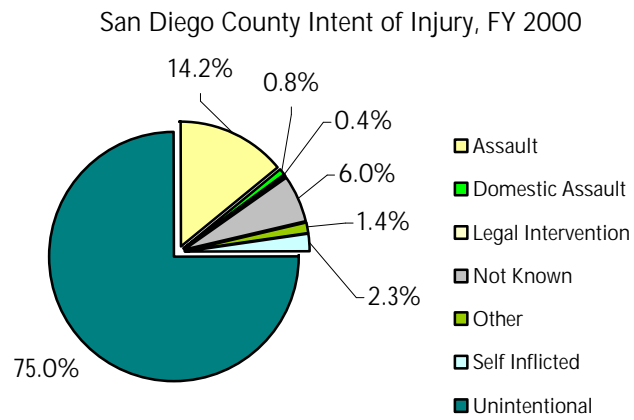
Exhibit 25 – Motor Vehicle Crashes by SRA



Source: SDEMSA Prehospital Dataset FY2000, n = 6,113

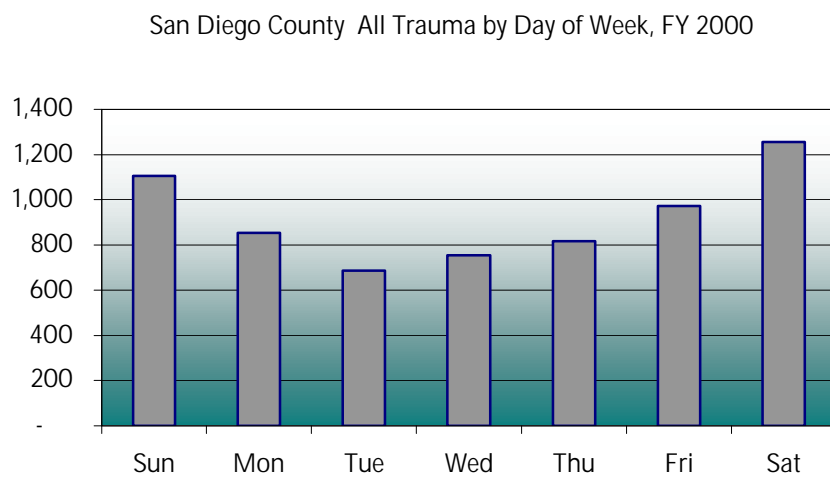


Exhibit 26 - Trauma by Intent of Injury



Source: SDEMSA Prehospital Dataset, n = 4,621

Exhibit 27 - Trauma by Day of the Week

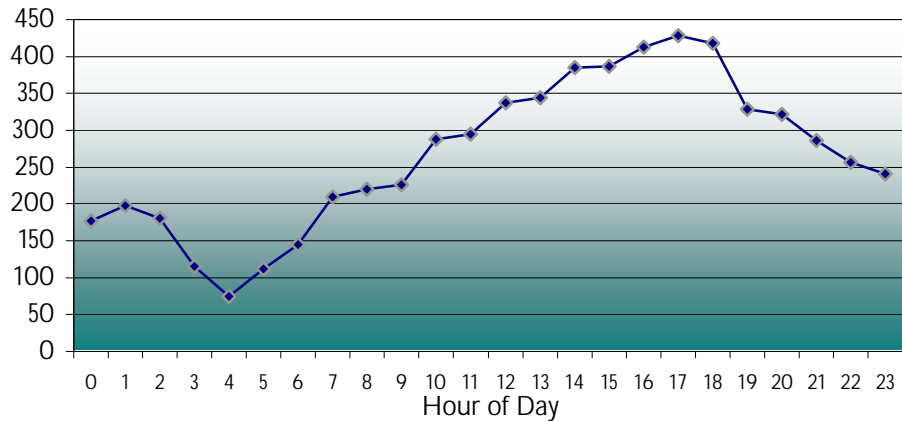


Source: SDEMSA Prehospital Dataset, n = 6,445



Exhibit 28 - Trauma by Hour of the Day

San Diego County Causes of Injury by Hour of Day, FY 2000

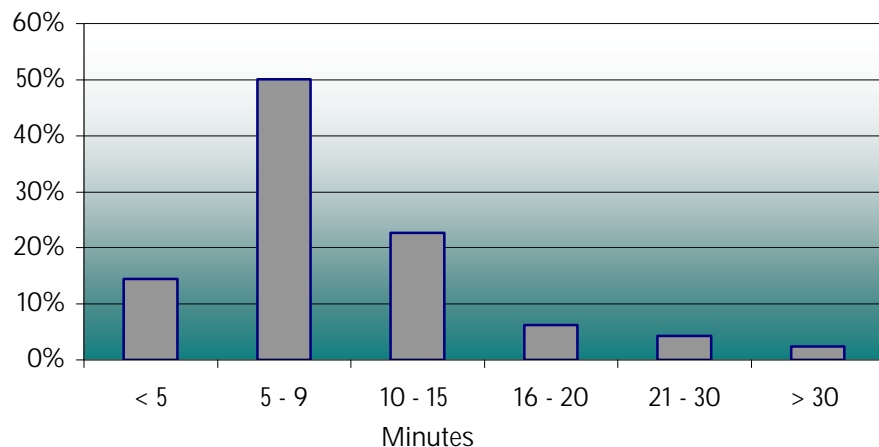


Source: SDEMSA Prehospital Dataset, n=6,388

The SDEMSA Prehospital Dataset for FY 2000 also provided response times to the trauma scene in San Diego County. For 14.4 percent of the patients the response time was less than 5 minutes to respond, while 50 percent of the time the response time was 5 to 9 minutes to respond. 22.6 percent of trauma patients were responded to within 10 to 15 minutes. Only 13 percent of trauma patients in San Diego County experienced a response time greater than 16 minutes.

Exhibit 29 - Response Time to Trauma Scene

San Diego County Response Times for Trauma, FY 2000

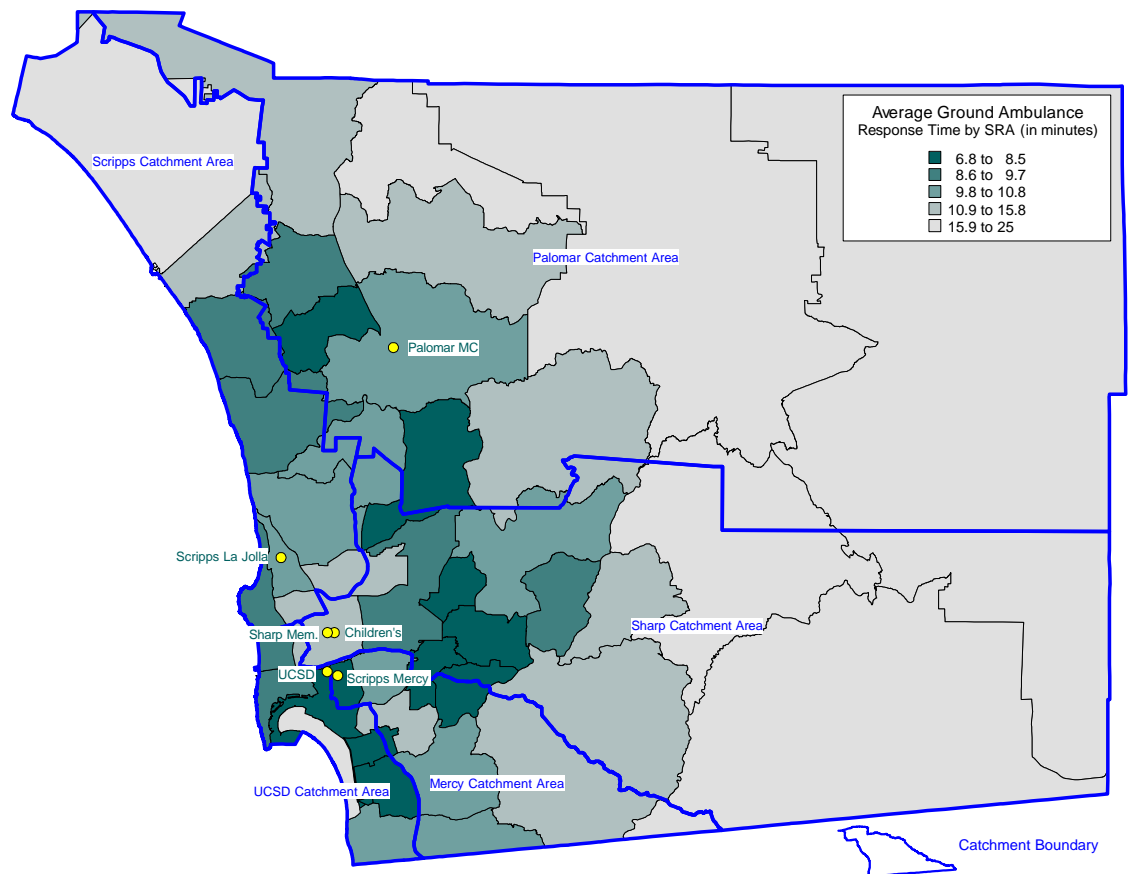


Source: SDEMSA Prehospital Dataset, n = 6,225



This following map illustrates the average ground ambulance response time by SRA. The response time is the difference between the time an ambulance receives a call and the time it arrives on the scene. Some of the SRAs with longer response times (core San Diego area) are most likely experiencing delays due to traffic conditions. Other areas with higher response times are impacted by longer distances to the scene.

Exhibit 30 - Average Ground Ambulance Response Time by SRA

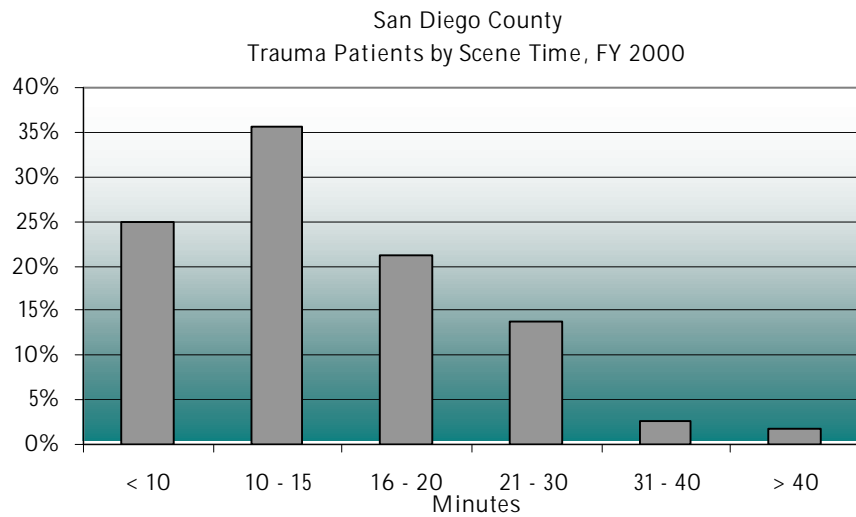


Source: SDEMSA Prehospital Dataset FY2000



The Abaris Group completed a similar analysis of prehospital data for scene times. Scene time is defined as the difference between the time the ambulance arrives at the scene to the time it is enroute to the hospital. One quarter of trauma patients were transported in less than 10 minutes, while the greatest percentage of transports (or 35.7 percent) occurred within 10 to 15 minutes. 18.1 percent all patients were transported in 21 minutes or more.

Exhibit 31 - Scene Time for Trauma Patients

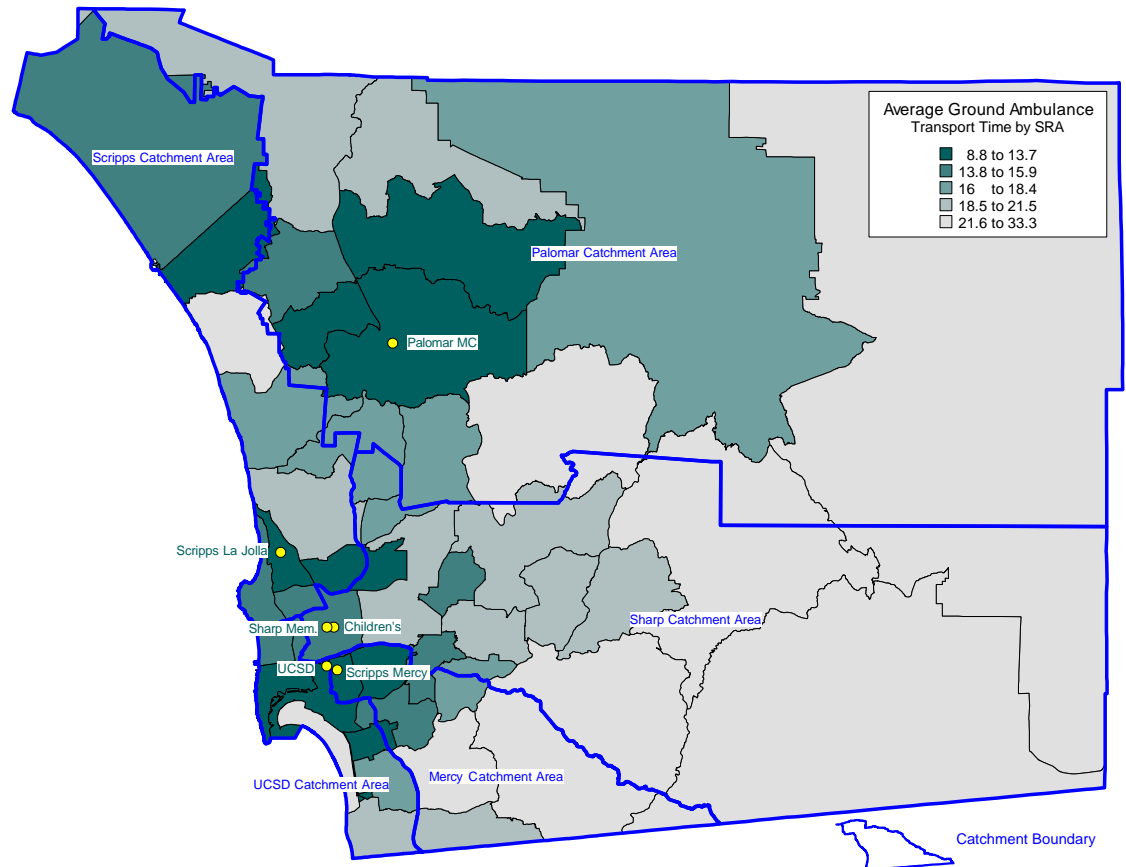


Source: SDEMSA Prehospital Dataset, n = 6,137



This map depicts the average ground transport time by SRA. Transport time is defined as the difference between the time an ambulance departs a scene and the time it arrives at a trauma center. All SRAs surrounding the trauma centers have an 8.8 to 13.7 minute transport time, reflective of their short transport distance (with the exception of one SRA in the Sharp catchment area).

Exhibit 32 - Average Ground Ambulance Transport Time by SRA

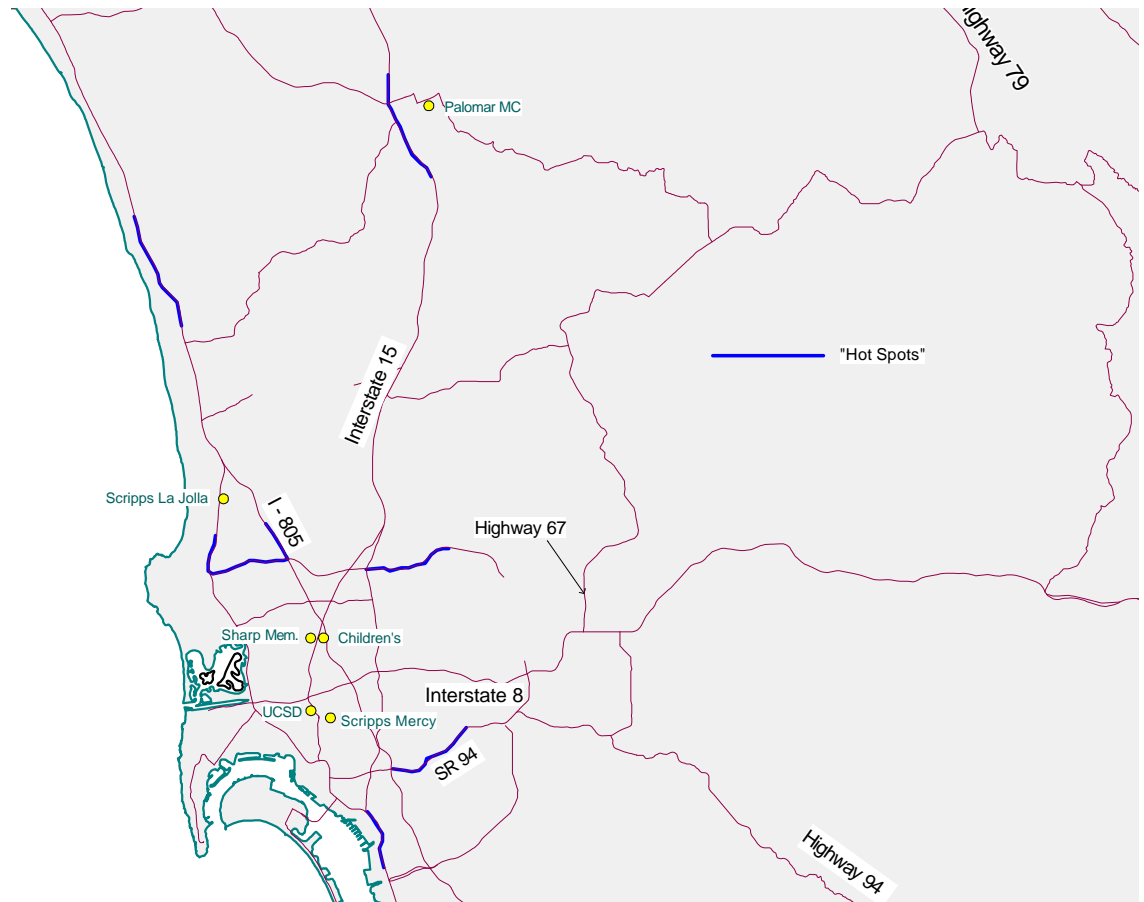


Source: SDEMSA Prehospital Dataset FY2000



As part of the transport and response review, The Abaris Group accessed traffic flow data from SANDAG for highways in the County. Highway areas identified as “hotspots” by SANDAG (defined as average weekday speed less than 35 MPH for greater than 4 hours per day) are illustrated on this map with a thick blue line. There are several “hot spots” on the San Diego highways. These areas may contribute to longer response and transport times of ground ambulance providers.

Exhibit 33 - Traffic "Hot Spots" in San Diego



Source: SANDAG, 2030 Draft Regional Transportation Plan, Technical Appendix 10

The following graph from the San Diego Trauma Registry shows the average length of stay for trauma patients in San Diego County. According to the SDEMSA, the average length of stay for trauma patients is approximately 5.5 days.

Exhibit 34 - Average Length of Stay

San Diego County Trauma Patient Length of Stay, 2001	
	Total
Average	5.5
N	5,108
Std. Deviation	8.9
Sum	28,044
Minimum	-
Maximum	120.8
Median	2.9
Average per day	76.8

Source: SDEMSA Trauma Registry

Nationwide Trauma Patient Characteristics

To provide an overview of patient characteristics nationwide, The Abaris Group referred to The National Trauma Data Bank (NTDB) Report 2002, which describes nationwide trauma patient characteristics for the period 1994 to 2001.³⁹ This data bank is the largest aggregate of trauma registry data ever assembled. The NTDB contains 430,557 records from 130 trauma centers across the United States.

According to NTDB, nationwide trauma patient profiles share similar characteristics with those of San Diego County. NTDB reported 64.2 percent of all trauma cases were men, while San Diego County reported 69.9 percent. NTDB reported that males outnumbered females by 3 to 1 in the 20- to 24 year-old age group.

When reported by age, NTDB data show that the number of trauma cases peaked at ages 17 to 24, declined and flattened out until the age of 40, then declined further

until a smaller second peak between ages 72 to 85. NTDB reported 10.1 percent of trauma patients were age 15 and under and 24.9 percent were age 55 and over. The San Diego County Trauma Registry reported slightly different percentages, which were 12.9 percent and 20.6 percent, respectively. NTDB showed a peak at ages 25 to 34, which is also what San Diego County reported. NTDB reported 17.3 percent of trauma patients were 25 to 34, while San Diego County reported 17.1 percent.

Like San Diego County, NTDB reported the most common mechanism of injury was motor vehicle related crashes, which accounts for 42.9 percent of all trauma cases. However, this is about 10 percent less than what San Diego reported (53.1 percent). The NTDB also reported falls as the second most common mechanism of injury, at 30.4 percent, which is double San Diego County's at 15.8 percent. At the national level, the third most common mechanism of injury was gunshot wounds and for San Diego County, gunshot wounds were the fifth most common mechanism.

³⁹ American College of Surgeons on Trauma: National Trauma Data Bank Report. Chicago IL, 2002

⁴⁰ The Abaris Group combined all motor vehicle related cases in one category, accounting for the slightly higher motor vehicle case rate.



Trauma Center Descriptive & Financial Data ED Data

The following data provides an overall description of capabilities, defines overall hospital and trauma center demand, and summarizes utilization statistics for the trauma centers.

Hospital-Wide Data

The trauma center hospitals range in size from 215 to 377 beds. There are a total of 226 ICU beds, 1,064 medical/surgical beds and 81 operating suites at these hospitals. In 2001, hospital admissions ranged from 12,400 to 20,900 with an average of 16,800. The average daily census for total patients ranged from 201 to 365 patients with an average of 288. The number of admissions for the EDs at trauma centers ranged from 5,044 to 10,758 with an average of 7,241. In 2001, the percentage of overall admitted patients admitted from the ED ranged from 24 to 61 percent with the average of 44 percent. In 2002, the average number of admissions from the ED was projected to fall to 6,860, with an average of 42 percent of admissions coming from the ED.

There was a wide range of ED visits at the hospitals in 2001 from 26,500 to 63,400 and a standard deviation of 11,300. The percentage of patients admitted to the hospital from the ED varied considerably from 9 to 26 percent. This factor is an indication of the overall acuity of the arriving ED patient. Another factor is the number of ED patients defined as "critical" using the OSHPD definition⁴¹. The range at the trauma centers was 2 percent to 44 percent.

A cost to charge ratio for each trauma center ED can be calculated from Medicare Cost Report data by comparing the reported costs to reported charges. The ratio varied considerably from 20 to 114 percent with an average of 52 percent and a standard deviation of 33 percent.

Trauma Department Data

In studying trauma systems, it is important to understand the different labels used for trauma patient categories. Exhibit 35 summarizes the definitions used in San Diego and provides summary data for each definition.

Exhibit 35 - Trauma Patient Definitions

San Diego County Trauma Definitions		
Term	Definition	Value
Trauma Arrivals	Patients receiving care at a designated trauma center; includes patients transported to the trauma department from the scene by EMS ("Trauma Transports"), patients	9,351 (FY01); 9,285 (CY01)
Trauma Transports	Patients transported to a trauma center by EMS that meet trauma triage criteria	6,445 (FY99/00)
Trauma Activations	Full and modified trauma team activations	8,856 (CY01)
Trauma Consults	Patients not a "trauma activation" but receiving an evaluation by one or more trauma team members for potentially traumatic injury.	708 (CY01)
Trauma Registry Patients	Patients meeting any of the following modified MTOS criteria: admission to the hospital for at least 24 hours; admission to an intensive or intermediate care unit; inter-facility transfer to or from an acute care hospital; or death from traumatic	5,169 (FY01); 5,123 (CY01)
Abbreviated Registry Patients	Patients meeting any of the following criteria: admission to the hospital (including LOS<24 hours); admission to an intensive or intermediate care unit; inter-facility transfer to or from an acute care hospital; or death from traumatic injuries	7,224 (FY01) includes 5,169 trauma registry patients above

Source: San Diego FY99/00 – Prehospital Database, FY01–Trauma Center Monthly Reports or Trauma Registry, CY01–individual trauma centers

⁴¹ OSHPD Definition of Critical EMS Visit: "a patient presents an acute injury or illness that could result in permanent damage, injury or death (head injury, vehicular accident, a shooting)."



Among the hospitals, trauma arrivals for CY 2001 ranged from 1,200 patients to 1,900 patients. Trauma triages and trauma activations ranged from 1,200 to 1,800. Trauma consults ranged from 67 to 146. Trauma case discharges from the ED ranged from 0 to 596 for CY 2001 and 0 to 636 for 2002 (projected based on data through September 2002). Transfers in for 2001 ranged from 24 to 288 and 31 to 344 for 2002 (projected). Transfers out ranged from 8 to 313 for 2001 and 12 to 316 for 2002 (projected).

The percentage of trauma cases discharged from the ED ranged from approximately 0 percent to 47 percent for CY 2001 and 0 percent to 48 percent for CY 2002 (projected). This is likely due to practice variations or variations in the use of the triage criteria or both.

Trauma Center Costs

The cost for trauma care at the six trauma centers in FY 2002 ranged from \$14.3 million to \$23.6 million, with the average being \$19.3 million. Using trauma cases, the resulting average cost of trauma care per patient ranged from \$9,800 to \$14,800, with the average being \$12,000. This variation may be due to variations in costs, practice variations or cost allocation methods.

Trauma centers provided their annual cost of specialty physician call coverage for trauma. Responses ranged from \$940,000 to \$3.0 million, with the average being \$1.7 million.

Trauma program office costs include trauma program manager, trauma medical director and registry and other support staff. The range in costs were \$175,960 to \$1,318,000. With the exception of one hospital, these costs also reflect trauma case managers if they exist at the hospital. The hospital case manager costs at the one hospital are in a separate cost center and could not be separately identified.

Even so the hospital's trauma program costs were not the lowest. As such, variation in trauma program office costs are considerably different. Differences in scope of the trauma program office, level of contribution by other departments to traditional trauma program office functions or institutional priorities could all affect these cost figures.

Trauma Center Revenue

Data from the Trauma Registry shows the median charge at the trauma centers in CY 2001 ranging from \$11,800 to \$37,000, with a median across all trauma centers of \$27,000. Net revenue in FY 2002 from hospital data ranged from \$10.7 million to \$31.8 million with an average of \$22.1 million and a standard deviation of \$6.8 million.

The trauma cost to revenue ratio ranged from 70 percent to 135 percent with an average of 93 percent and a standard deviation of 22 percent. The following charts provide individual data requested by the County of San Diego or The Abaris Group to complete this study. Each table summarizes the data and describes the data sources.



Table A: Hospital Data

Data Item	Reporting Period	Children's	Palomar	Scripps La Jolla	Scripps Mercy	Sharp	UCSD	Count	Min	Max	Avg	St Dev
Hospital		Source										
Total Hospital Beds (Available)	As of 10/02	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	215	377	307	50
ICU Beds	As of 10/02	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	24	66	38	14
Med/Surg Beds	As of 10/02	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	101	364	177	91
Surgical Suites	As of 10/02	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	10	17	14	3
Hospital Admissions	CY01	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	12,401	20,890	16,842	3,375
Hospital Admissions	Proj. CY02	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	10,449	23,948	16,931	4,632
Hospital Discharges	FY01	OSHPD	OSHPD	OSHPD	OSHPD	OSHPD	OSHPD	6	12,379	22,786	19,101	3,591
Number of Admissions from ED to Hospital	CY01	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	5,044	10,758	7,241	2,217
Number of Admissions from ED to Hospital	Proj. CY02	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	4,328	8,807	6,860	1,634
Percentage of Total Admissions Coming from ED	CY01	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	24%	61%	44%	13%
Percentage of Total Admissions Coming from ED	Proj. CY02	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	24%	59%	42%	11%
Average Daily Census	FY01	OSHPD	OSHPD	OSHPD	OSHPD	OSHPD	OSHPD	6	201	365	288	56
ALOS for all patients (excluding long-term care)	FY01	OSHPD	OSHPD	OSHPD	OSHPD	OSHPD	OSHPD	6	4.0	5.8	5.0	0.8

Table B: Emergency Dept. Data

Data Item	Reporting Period	Children's	Palomar	Scripps La Jolla	Scripps Mercy	Sharp	UCSD	Count	Min	Max	Avg	St Dev
Emergency Department		Source										
ED Visits (Hosp. data)	CY01	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	26,503	63,422	42,899	11,268
ED Visits (Hosp. data)	Proj. CY02	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	28,103	52,100	40,855	7,517
ED Visits (OSHPD data)	CY01	OSHPD	OSHPD	OSHPD	OSHPD	N/R	OSHPD	5	26,574	67,701	43,235	13,591
ED Visits Admitted to Hospital (Hosp. data)	CY01	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	5,044	10,758	7,241	2,217
ED Visits Admitted to Hospital (Hosp. data)	Proj. CY02	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	4,328	8,807	6,860	1,634
ED Visits Admitted to the Hospital (OSHPD data)	CY01	OSHPD	OSHPD	OSHPD	OSHPD	N/R	OSHPD	5	4,959	10,467	6,932	2,174
"Critical" ED Patients (OSHPD data)	CY01	OSHPD	OSHPD	OSHPD	OSHPD	N/R	OSHPD	5	1,048	16,625	6,288	5,564
ED Diversion Hours	CY01	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	6	59	3,416	2,347	1,152
ED Diversion Hours	CY02	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	6	22	2,718	1,818	928
ED Total Costs (000's)	FY01	MediCal Cost Report	MCR	MCR	MCR	MCR	MCR	6	\$ 4,794	\$ 12,040	\$ 9,267	\$ 2,540
ED Total Charges (000's)	FY01	MediCal Cost Report	MCR	MCR	MCR	MCR	MCR	6	\$ 10,528	\$ 32,711	\$ 21,784	\$ 7,175
Percentage of ED Visits Admitted to Hospital (Hosp. data)	CY01	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	9%	26%	18%	6%
Percentage of ED Visits Admitted to Hospital (Hosp. data)	Proj. CY02	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	8%	25%	18%	5%
Percentage of ED Visits Admitted to Hospital (OSHPD data)	CY01	OSHPD	OSHPD	OSHPD	OSHPD	N/R	OSHPD	5	8%	28%	17%	6%
Percentage of ED Patients Designated "Critical" (OSHPD data)	CY01	OSHPD	OSHPD	OSHPD	OSHPD	N/R	OSHPD	5	2%	44%	17%	15%
ED Cost to Charge Ratio	CY01	MediCal Cost Report	MCR	MCR	MCR	MCR	MCR	6	20%	114%	52%	33%

Note: MCR stands for Medicare Cost Report, FY2001

Table C: Trauma Data

Data Item	Reporting Period	Children's	Palomar	Scripps La Jolla	Scripps Mercy	Sharp	UCSD	Count	Min	Max	Avg	St Dev
Trauma		Source										
Trauma Arrivals	CY01	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	6	1,223	1,927	1,548	255
Trauma Arrivals	FY02	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	6	1,285	1,974	1,591	250
Trauma Triages	CY01	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	1,221	1,782	1,504	210
Trauma Triages	Proj. CY02	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	1,097	1,936	1,579	296
Trauma Activations	CY01	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	1,221	1,774	1,476	214
Trauma Activations	Proj. CY02	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	1,095	1,936	1,532	283
Trauma Consults	CY01	Not Tracked	Not Tracked	Hosp.	Hosp.	Hosp.	Hosp.	4	67	146	118	30
Trauma Activations	Proj. CY02	Not Tracked	Not Tracked	Hosp.	Hosp.	Hosp.	Hosp.	4	79	153	127	29
Trauma Registry Patients	CY01	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	6	644	1,082	854	158
Trauma Admissions to Hospital	CY01	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	679	1,723	1,179	377
Trauma Admissions to Hospital	Proj. CY02	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	569	1,936	1,217	472
Trauma Discharges from ED*	CY01	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	0	596	324	192
Trauma Discharges from ED*	Proj. CY02	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	0	636	362	223
Trauma ALOS (MMTOS)	CY01	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	6	4.3	6.6	5.5	0.8
Trauma Transfers In	CY01	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	24	288	158	96
Trauma Transfers In	Proj. CY02	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	31	344	176	98
Trauma Transfers Out	CY01	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	8	313	85	105
Trauma Transfers Out	Proj. CY02	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	12	316	90	106
Trauma Bypass Hours	CY01	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	6	32	513	148	165
Trauma Bypass Hours	CY02	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	6	9	175	102	54
Median Trauma Charge (MMTOS pts.)	CY01	SDC EMSA	N/R	SDC EMSA	SDC EMSA	SDC EMSA	SDC EMSA	5	\$ 11,769	\$ 37,045	\$ 27,022	\$ 8,819
Specialty Physician Costs for Trauma (000's)	As of 10/02	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	N/R	5	\$ 940	\$ 2,992	\$ 1,717	\$ 696
Trauma Program Office Cost	FY01	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	\$ 175,958	\$ 1,318,222	\$ 629,259	\$ 360,961
Trauma Costs (000's)	FY02	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	\$ 14,342	\$ 23,562	\$ 19,274	\$ 3,773
Trauma Net Revenue (000's)	FY02	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	\$ 10,667	\$ 31,842	\$ 22,096	\$ 6,792
Avg. Cost of Trauma Care per Pt.	FY02	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	\$ 9,837	\$ 14,810	\$ 12,126	\$ 1,633
Percentage of Trauma Triages Admitted to Hospital	CY01	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	53%	100%	77%	15%
Percentage of Trauma Triages Admitted to Hospital	Proj. CY02	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	52%	100%	74%	18%
Percentage of Triages Discharged From ED*	CY01	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	0%	47%	23%	16%
Percentage of Triages Discharged From ED*	Proj. CY02	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	0%	48%	26%	18%
Trauma Cost to Revenue Ratio	FY02	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	Hosp.	6	70%	135%	93%	22%

* Trauma discharges from the ED are estimated by the difference between Trauma Triages and Trauma Admissions to Hospital, not taking into account transfers or deaths.

San Diego County Trauma Volume Projections

Purpose

Trauma patient volumes are an important indicator of resource needs and capacity demands for hospitals. They also assist with predicting overall system resources. Future demand is also an important element of calculating future financial needs of the system.

San Diego trauma center volume has fluctuated by year with an average of 7.0 percent over the 18 years of the program. During the past four years the growth has averaged 4.2 percent.

Methodology

Population changes have historically been an important predictor of trauma volume. In order to confirm the predictive value for San Diego, The Abaris Group ran a simple linear regression (using a time series of trauma volume as the dependent variable and population as the independent variable). The findings demonstrated that there is a reasonable linear relationship between the two⁴². Thus, The Abaris Group's initial efforts focused on using population as the driver for the volume projections.

The Abaris Group used four different methods for predicting future trauma volumes:

- (1) Projected based on population growth per zip code and compared to EMS transports by zip code
- (2) Using historical utilization rates by trauma center catchment area with trauma center catchment projections provided by the San Diego County EMS Agency

- (3) Same as number two but adjusted for the pediatric population
- (4) Historical trauma volume change for each trauma center using a weighted growth rate

While all four methods showed growth, the first three tended to understate growth (under two percent per year) which is inconsistent with historical growth even though the population growths were similar. Therefore, The Abaris Group chose the fourth methodology as the principal source for projections.

For this method, The Abaris Group reviewed the historical change in trauma volume for each trauma center. The historical data were submitted by each trauma center to the San Diego County EMS Agency via the monthly hospital trauma data reports. The percent change was calculated for each year and a weighted average growth rate was developed (to smooth out the fluctuations experienced by each trauma center). Using a weighted average is common in forecasting because, in general, it is believed that the recent past is a better predictor of the future and should be given more weight than the previous years. The Abaris Group assigned the percent change for FY02 the largest weight (50 percent) and the percent change for FY00 and FY01 were assigned a weight of 25 percent each.

Using this projection method, trauma volume for the county is expected to rise from FY2002 9,545 to 13,223 in FY 2010. The annual growth rate is expected to be 4.2 percent. These projections assume no changes in the catchment area boundaries.

The following exhibit presents The Abaris Group projections.

42 The Coefficient of Determination (R^2) was .683 (a value of .70 and greater is considered good) and the Coefficient of Multiple Correlation (Multiple R) was .826 (a value close to 1 indicates a strong relationship).



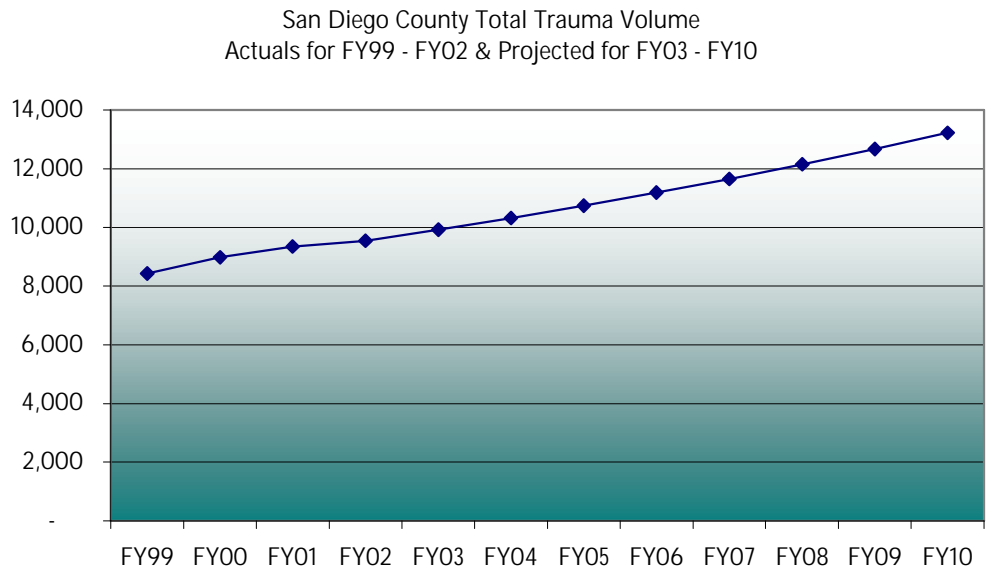
San Diego County Trauma Volume Projections

Projected Arrivals (or Admissions)														
Trauma Center	Actuals				Projections									Growth
	FY99	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY03 to FY10	
Children's	1,341	1,486	1,338	1,333	1,333	1,334	1,334	1,334	1,335	1,335	1,335	1,336	0.02%	
Palomar	1,163	1,143	1,160	1,285	1,353	1,426	1,502	1,582	1,666	1,755	1,848	1,947	5.48%	
Scripps La Jolla	1,109	1,284	1,469	1,458	1,563	1,675	1,795	1,924	2,061	2,209	2,368	2,538	7.80%	
Scripps Mercy	1,622	1,797	1,889	1,974	2,097	2,227	2,366	2,514	2,670	2,836	3,013	3,201	6.58%	
Sharp	1,571	1,646	1,818	1,771	1,816	1,861	1,908	1,956	2,005	2,055	2,107	2,160	2.37%	
UCSD	1,629	1,628	1,677	1,724	1,761	1,799	1,837	1,876	1,916	1,957	1,999	2,042	2.00%	
Total	8,435	8,984	9,351	9,545	9,923	10,321	10,742	11,185	11,654	12,148	12,671	13,223	4.16%	
Percent Change	-	6.51%	4.09%	2.07%	3.96%	4.02%	4.07%	4.13%	4.19%	4.24%	4.30%	4.36%	-	
Annual Average Change	-	-	-	4.21%										
Percent Change														
					3 Year Weighted Average									
	FY99	FY00	FY01	FY02										
Children's	-	10.8%	-10.0%	-0.4%	0.0%									
Palomar	-	-1.7%	1.5%	10.8%	5.3%									
Scripps La Jolla	-	15.8%	14.4%	-0.7%	7.2%									
Scripps Mercy	-	10.8%	5.1%	4.5%	6.2%									
Sharp	-	4.8%	10.4%	-2.6%	2.5%									
UCSD	-	-0.1%	3.0%	2.8%	2.1%									

Source: SDEMSA Monthly Trauma Reports, The Abaris Group.

The following exhibits illustrate the current and expected trauma volume for the entire county and for each trauma center.

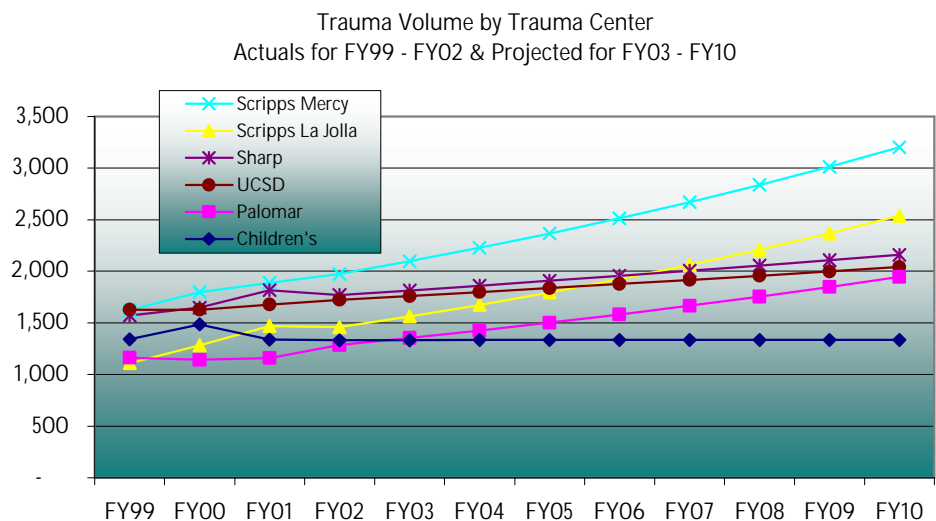
Exhibit 40 - San Diego County Actual &



Source: SDEMSA Monthly Trauma Center Reports, The Abaris Group.

Projected Trauma Volume

Exhibit 41 - San Diego County Actual & Projected
Trauma Volume by Trauma Center



Source: SDEMSA Monthly Trauma Center Reports, The Abaris Group.



Discussion

There are a variety of factors that affect trauma volume. Clearly age distribution and epidemiology are critical factors. According to SANDAG, the overall population growth rate is expected to be 1.4 percent per year, but the pediatric population (0 – 14) is expected to be only .04 percent per year. The projected population for San Diego is expected to increasingly age. The older population (60 years plus) is expected to grow 3.4 percent (faster than the overall growth rate). Currently the population aged 60 and older make up 14.4 percent, while in 2010, that same segment will comprise almost 17 percent of the total population. Older populations tend to have more comorbid risk factors and their increase could cause a rise in trauma cases. The Abaris Group's predictions show conservative trauma center growth for pediatric cases and more substantial growth for adults.

An increase in prevention efforts could also decrease trauma cases, but historical trauma incidence rates in San Diego County have remained high in spite of robust community prevention efforts. Increased daytime populations to high business density areas could have a threefold affect by 1) increasing the daily population to a trauma catchment area, 2) decreasing the population from the bedroom community it comes from, and 3) increasing risk along traffic corridors during commute times. Other factors might include the social and environmental changes that affect a portion of motor vehicle crashes (improved roadways), assaults (increase in gang activity) or even special events resulting in a population spike (Super Bowl).

There are at least two other populations that impact the San Diego region – tourists and undocumented immigrants. While the overall population growth in San Diego County is projected to be modest, there are a significant number of tourists who visit the region annually. The San Diego Convention & Visitors Bureau estimated the number of overnight visitors to San Diego at 14.8 million in 2001 – almost five times the region's resident population. Also, not included in the population projections is the transient immigrants who cross the Mexico/US border into San Diego. The *San Diego County Trauma System Plan 2002* cites the number of transient immigrants at 2.9 million³⁹. Baseline trauma volumes for FY02 already include the volume generated from these two unique populations. However, a dramatic shift in these populations would affect the trauma volume projections.

³⁹ County of San Diego, Health and Human Services Agency, Division of Emergency Medical Services: *County of San Diego Trauma System Plan 2002*, p. 1-2.



Trauma Center Financial Projections

Purpose

The Abaris Group compiled financial data from the trauma centers in San Diego County to understand their current financial situations and project changes over the next several years. Some trauma center data used in the calculations were also from the Phoenix Healthcare Consulting report.

Methodology

The Abaris Group met with each trauma center and discussed their costs and revenue calculation tools. The method of producing revenue was consistent amongst all six hospitals. There were some variation in costing methods between the hospitals but all were able to use a method that specifically calculated trauma patient and services costs to a level of detail and confidence satisfactory to The Abaris Group.

Each hospital supplied data for fiscal year 2002. San Diego County's trauma volume data for fiscal year 2002 (July – June) were used for the base 2002 year. Minor differences between the trauma center fiscal patient volume and the County's were thought to be due to timing as well as different methods for hospital fiscal reporting compared to methods used at the trauma registry level. Each hospital's revenue and cost data were adjusted to reflect the appropriate volume of cases used.

The fiscal year data source was chosen as it more closely represented actual revenue and costs. However, there are slight variations with the fiscal years. Three hospitals use July to June fiscal years and three use October to September fiscal years. These variations in fiscal year timing were not considered by The Abaris Group to be a problem as there should be consis-

tency of the annual trauma patient profiles for each hospital.

Using the hospital data reported for fiscal year 2002 as the baseline year, The Abaris Group calculated projections to fiscal year using the assumptions of a nine percent per year cost increase and a seven percent net revenue increase. This cost assumption is justified due to the higher past medical cost index increases in San Diego, recent past higher costs of labor (e.g. staffing registries and new labor contracts) and the overall high technology increases prevalent in health and trauma care. Revenue assumptions were deemed aggressive but necessary to achieve a reasonable period of cost recovery. Even so, these revenue assumptions need to be carefully monitored in light of anticipated reductions in Medicare and MediCal revenue and the increasing inability of hospitals to get full cost recovery from other payers. It is also recognized in the healthcare industry that a positive margin of at least six percent is needed for most health product lines to survive to assure stability and that a contribution is made to future capital needs.

Assumptions, baseline and projected revenue and cost calculations were shared and approved by each trauma center. The Abaris Group trauma volume projections were also used for the financial projections. The Abaris Group included future trauma care and SB12/612 funding as part of each trauma center's net revenue for the period of time predicted.

Results

Exhibit 42 shows a composite of the financial performance of San Diego County's trauma centers. The net result is an actual gain in 2002 of \$16.9 million but a projected loss beginning in 2006 and a steady decline over the next four years to a \$7.7 million. This is due to increasing costs and the inability of revenue to keep pace with the costs. The picture in San



Diego is consistent with other studied trauma centers with typically wide shifts in revenue/costs based on acuity of patients and length of stay and the shifting of the very fragile payment system upon which trauma centers exist.



Trauma Center Financial Projections
Summary of All San Diego County Trauma Centers

	Actual FY 2002	Estimate FY 2003	Estimate FY 2004	Estimate FY 2005	Estimate FY 2006	Estimate FY 2007
Volume						
Trauma Cases	9,516	9,923	10,322	10,742	11,186	11,653
Percent Change	-	4.3%	4.0%	4.1%	4.1%	4.2%
Net Revenue						
Patient Revenue	\$127,513,873	\$137,540,565	\$153,691,744	\$171,811,608	\$192,173,047	\$215,002,284
Trauma Care Funding ¹	4,852,537	2,660,452	-	-	-	-
Maddy, SB12/612 Funds ¹	207,012	307,790	307,790	119,216	119,216	119,216
Total Revenue	132,573,422	140,508,807	153,999,534	171,930,824	192,292,263	215,121,500
Percent Change	-	6.0%	9.6%	11.6%	11.8%	11.9%
Expenses						
Total Expenses	115,644,269	132,188,831	150,505,751	171,433,495	195,386,468	222,771,553
Percent Change	-	14.3%	13.9%	13.9%	14.0%	14.0%
Net Operating Income	16,929,154	8,319,976	3,493,783	497,328	(3,094,205)	(7,650,053)
Percent Change	-	-50.9%	-58.0%	-85.8%	-722.2%	-147.2%
Margin	14.6%	6.3%	2.3%	0.3%	-1.6%	-3.4%

Source: Cost and revenue data provided by five trauma centers using their FY02 and extrapolated for one trauma center using their FY01. Cost and revenue per patient reported by hospitals were applied to volume reported by SDEMSA for FY02 (Jul - Jun).

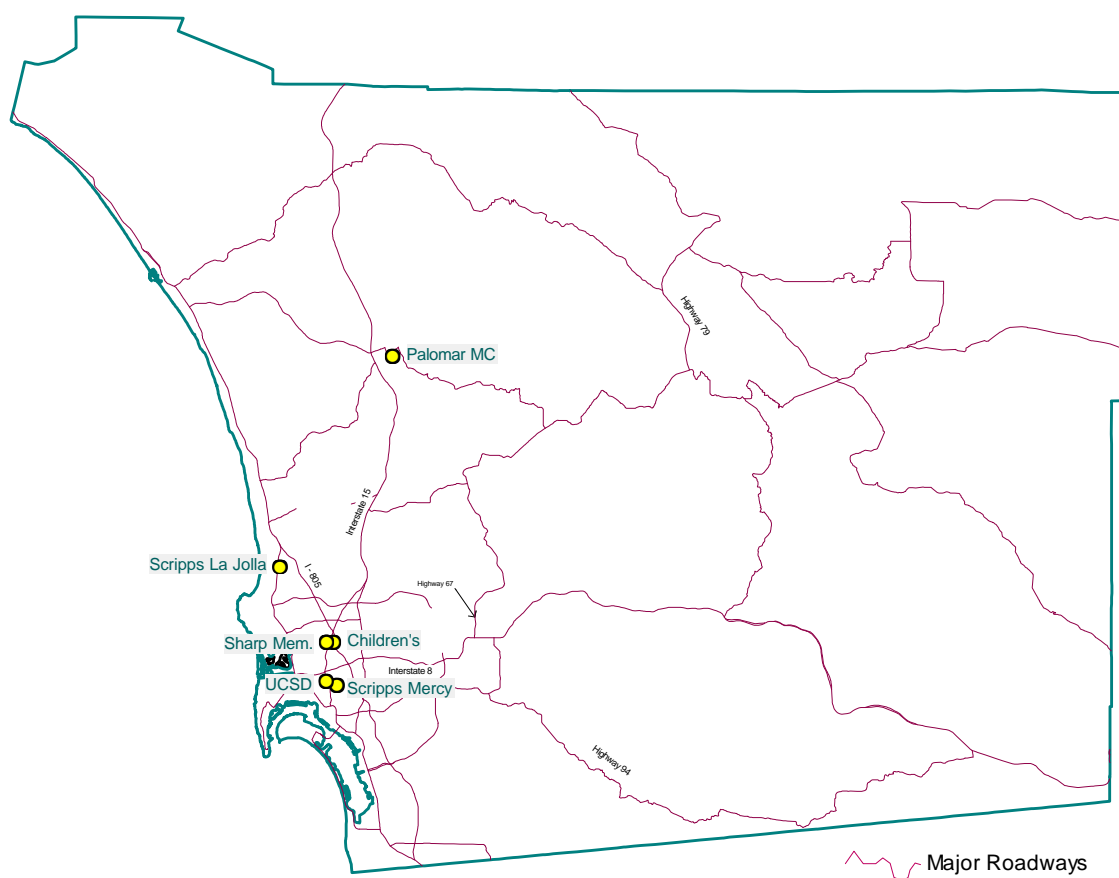
¹Assumes trauma care funding for FY02 and FY03, SB12/612 funds provided for FY02 to FY07 and Maddy Fund for FY02-04.

Additional San Diego County Trauma Maps

The following series of maps were generated using map files from SANDAG and data from the San Diego County EMS Agency. These maps provide support to the population, roadway and trauma volume commentary provided in this report.

Four trauma centers, Scripps Mercy, Sharp, Children's and UCSD, are in close proximity to one another in the central region of San Diego. Scripps La Jolla is north of the cluster, while Palomar is located much farther north along Interstate 15.

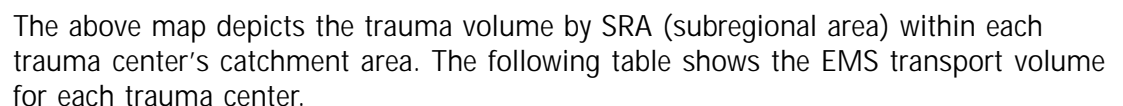
Exhibit 43 - Location of Trauma Centers and Major Roadways



Source: SANDAG, SDEMSA



Exhibit 44 - The Number of Trauma Cases by SRA

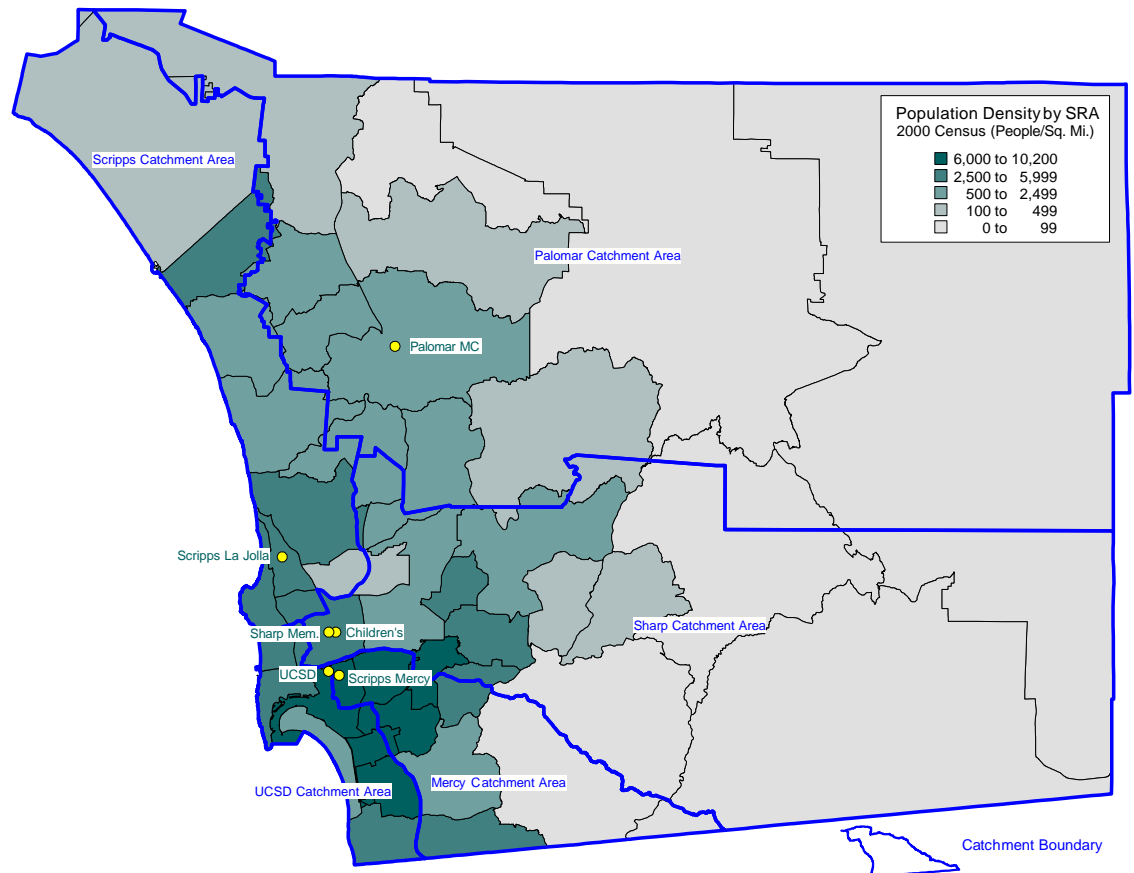


Trauma Center Volume, FY00

Source: SDEMSA Prehospital Database FY00, n=6,113

The 2000 population of San Diego County was 2,813,833. The SRAs in the eastern part of the county have a lower population density, while those in the western region are much more densely populated. Palomar and Sharp have the largest square mile catchment areas. However, several of the SRAs within their catchment areas are sparsely populated. The other hospitals are located in areas with more densely populated SRAs.

Exhibit 46 - Population Density by SRA

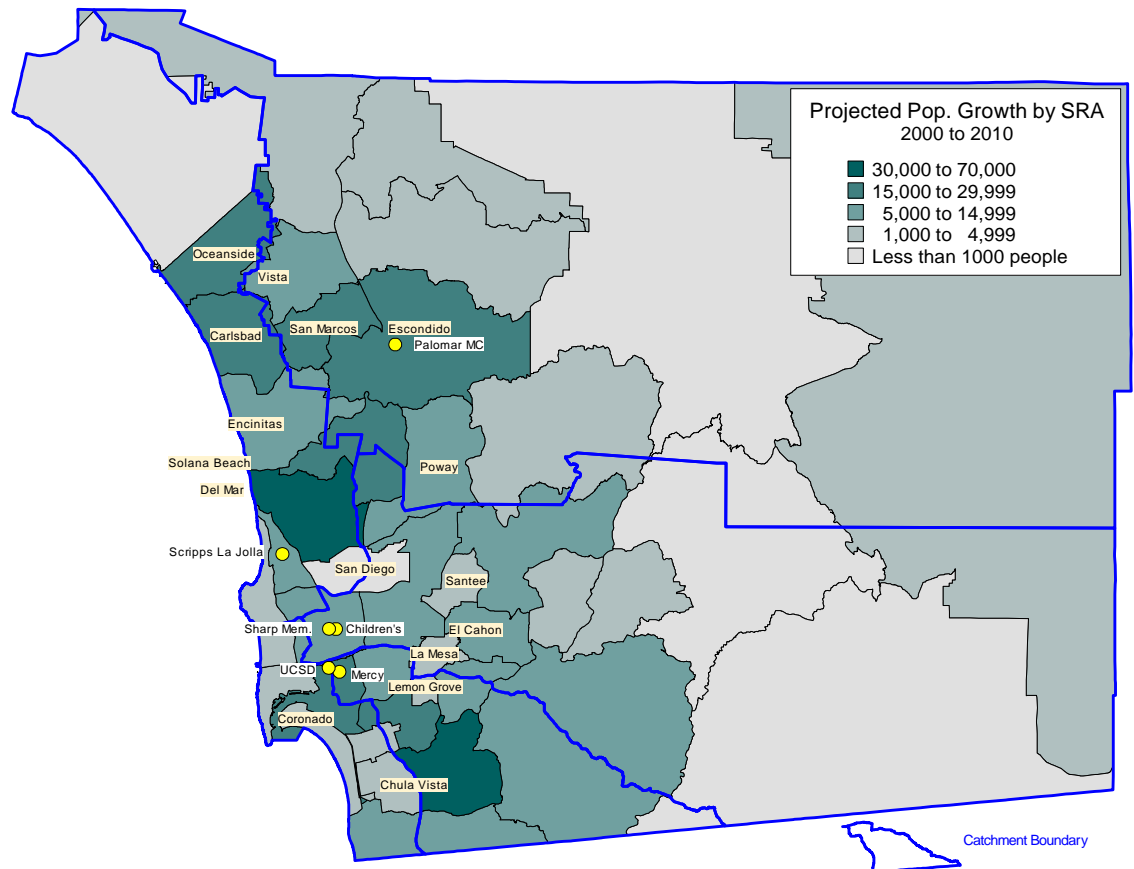


Source: SANDAG, 2000 Census



According to SANDAG, the projected population growth rate for San Diego County from 2000 to 2010 will be an average of 1.4 percent per year. SRAs that are projected to grow significantly (adding 30,000 – 70,000 people by 2010) are in the Chula Vista area and the Del Mar-Mira Mesa area. Other SRAs that are projected to grow (adding 15,000 – 29,999 people by 2010) include the areas around Escondido, San Marcos, Carlsbad, Oceanside, and central San Diego. SANDAG population projections show the east county region to be an area with comparatively little growth in the next 10 years (less than 1,000 to 4,999 people by 2010).

Exhibit 47 - Projected Population Growth by SRA for 2000 to 2010

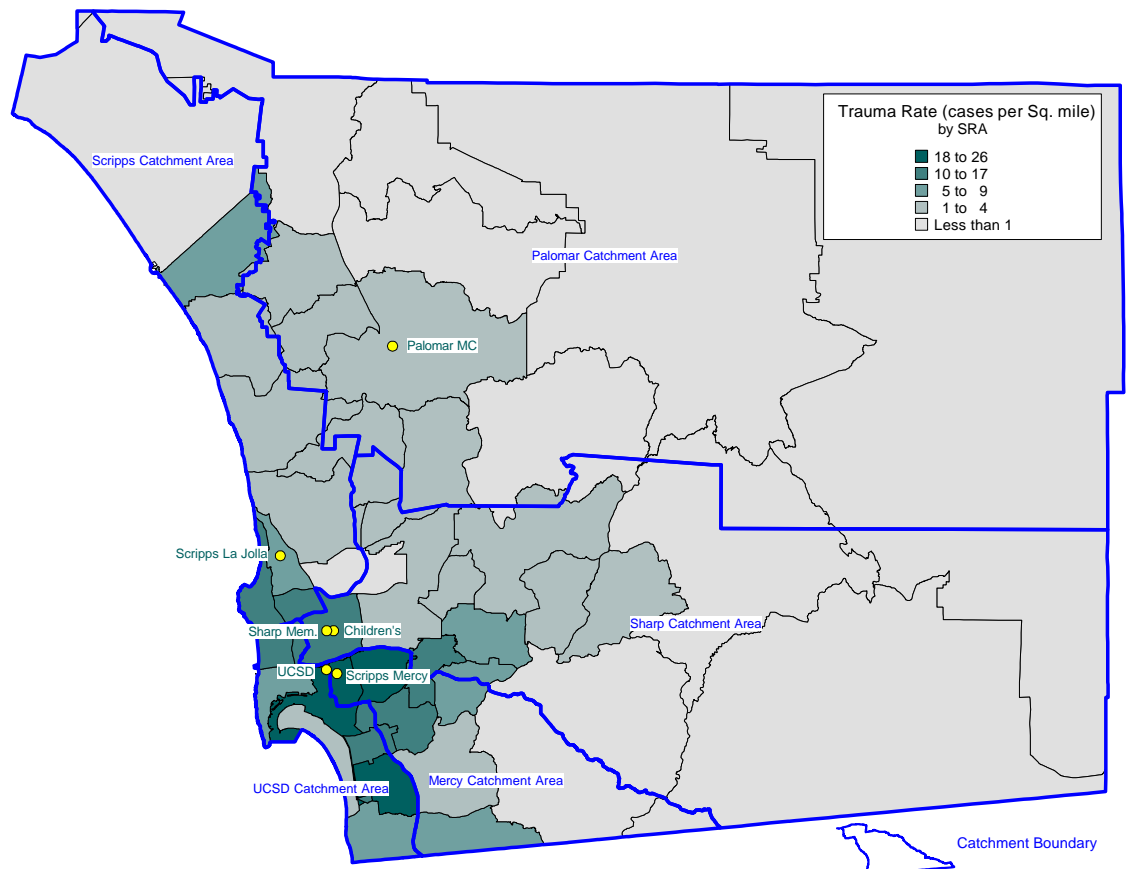


Source: SANDAG, Preliminary Projections, Released October 2002



The SRAs with the greatest density of trauma cases (18 to 26 cases per square mile) are in the Scripps Mercy and UCSD catchment areas. Those SRAs with 10 to 17 cases per square mile are mostly located in the Sharp, Scripps La Jolla, Scripps Mercy and UCSD catchment areas.

Exhibit 48 - Trauma Rate per Square Mile by SRA

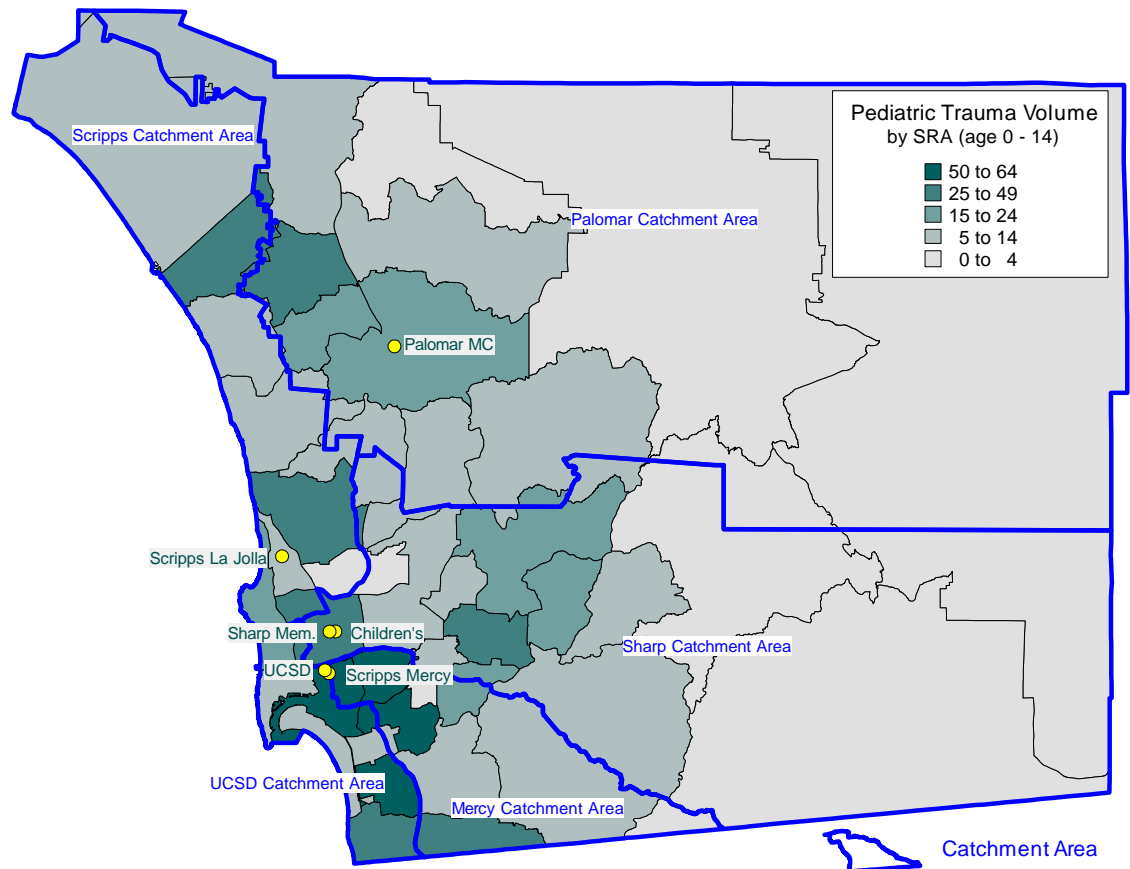


Source: SDEMSA Prehospital Dataset FY2000, n = 6,113



Pediatric (0 – 14 years of age) trauma cases in the county are treated at Children's. The incidence of pediatric trauma is highest in the central region of San Diego.

Exhibit 49 - Pediatric Trauma Volume (Aged 0 - 14) by SRA

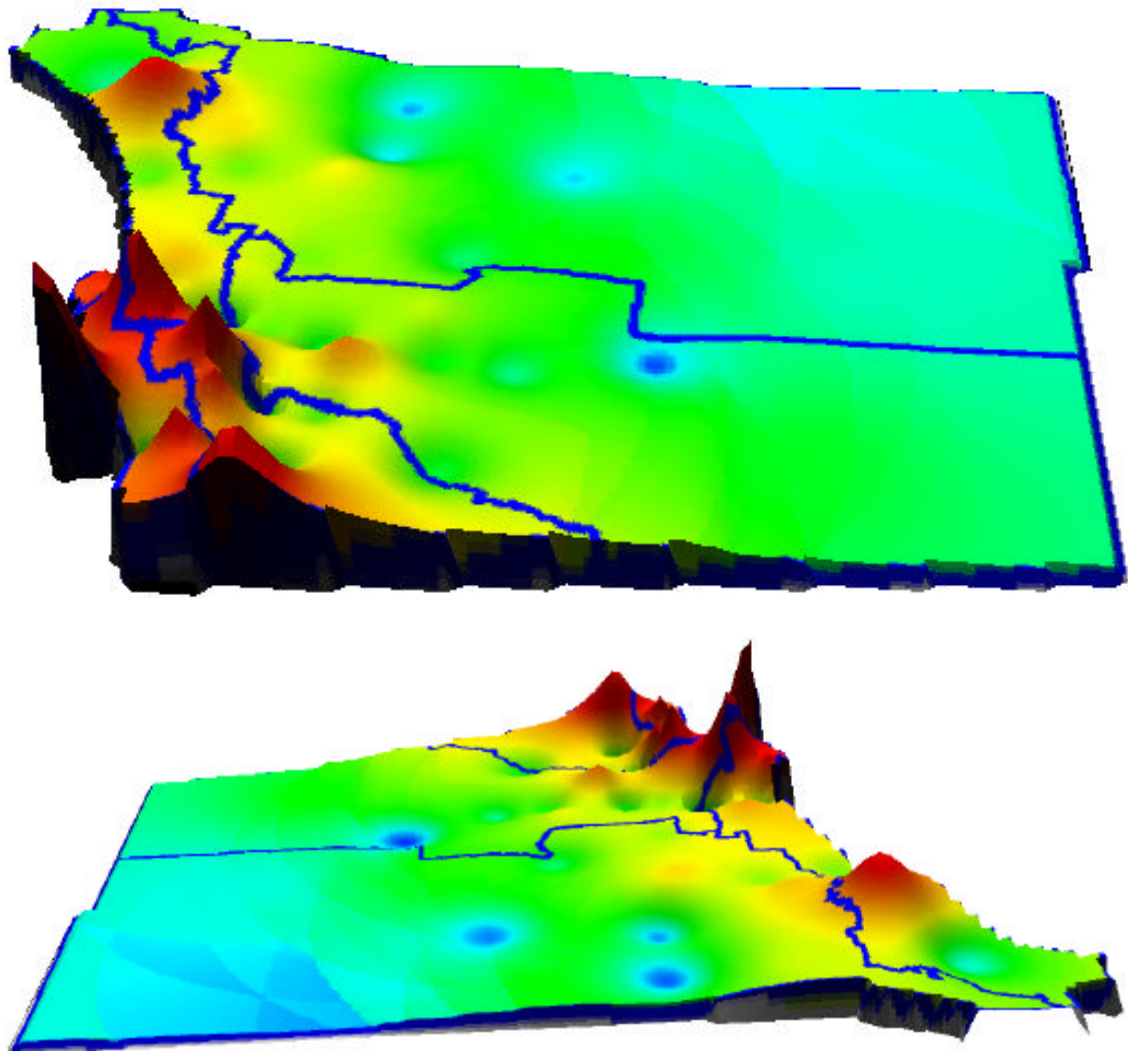


Source: SDEMSA Prehospital Dataset FY2000, n = 1,620

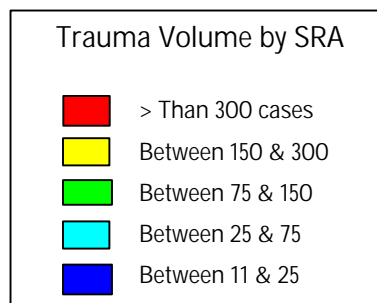


This map uses both thematic characteristics and elevation to depict trauma volume by catchment area. The second view is from the North County border, providing a dramatic view of the trauma volume.

Exhibit 50 - 3-D Illustration of Trauma Volume SRA With Catchment Areas

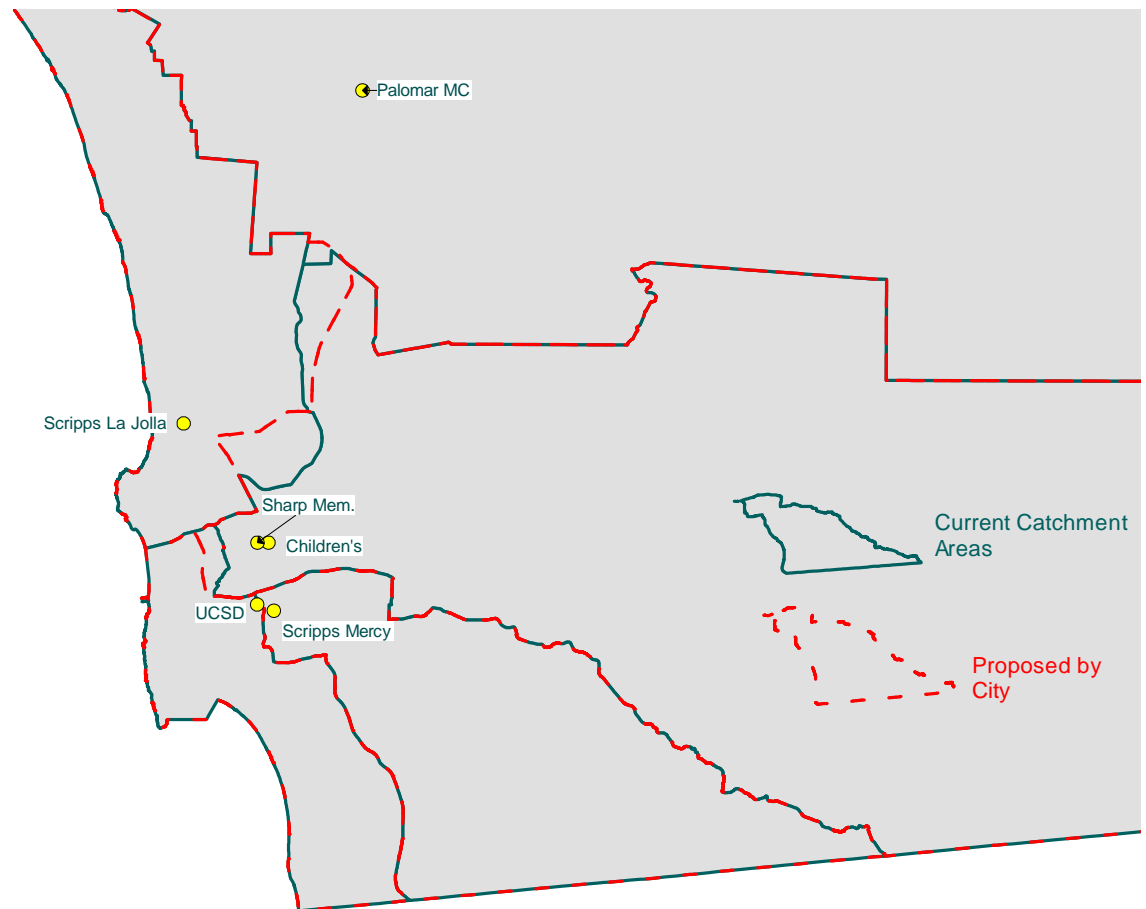


Source: SDEMSA Prehospital Dataset FY2000, n = 6,113



This map illustrates the current catchment areas for the trauma centers and the changes proposed by the San Diego City Fire Department. Proposed changes to the existing catchment zones only occur in the core area of San Diego and are minimal. Using the transport data provided by QANet, The Abaris Group was able to estimate the changes in volume for those catchment areas impacted by the change. UCSD would lose 3 square miles and approximately 40-50 cases, Sharp would gain approximately 4 square miles and 70 – 80 cases, and Scripps La Jolla would lose approximately 4 square miles and 70 – 80 cases.

Exhibit 51 - Proposed Trauma Catchment Areas by San Diego City Fire Department



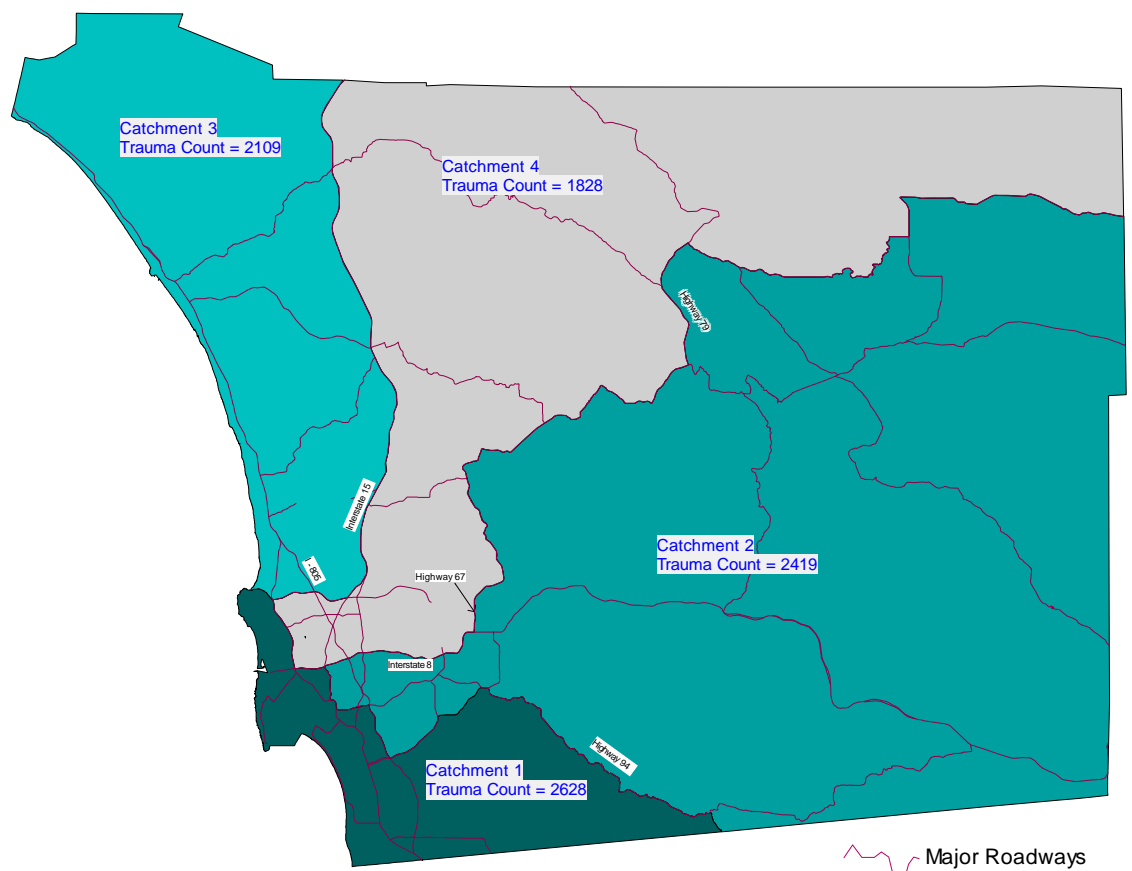
Source: SANDAG and the San Diego City Fire Department



The Abaris Group completed an analysis of the impact on configuration of the San Diego County trauma system if one or two trauma centers dropped out of the system. FY00 Prehospital Database for EMS transports was used as the base line (this being the most current smaller level geographic data available). The Abaris Group staff followed major roadways and freeways in redrawing the boundaries. Each SRA was reviewed and allocated to the appropriate suggested catchment. Those SRAs that straddled a boundary were allocated to the suggested catchment areas proportionately, based upon the percentage of the SRA that fell in each catchment area. The trauma volume for the SRA was then distributed to the catchment area according to that percentage. Finally, The Abaris Group staff calculated a multiplier to apply to each SRA to increase the EMS transport numbers to the more appropriate trauma arrivals figure. Pediatric volume is accounted for in each catchment's total trauma count.

This map illustrates a possible revision to the trauma catchment areas if one trauma center dropped out of the system.

Exhibit 52 - Effect of One Trauma Center Leaving the San Diego County Trauma System

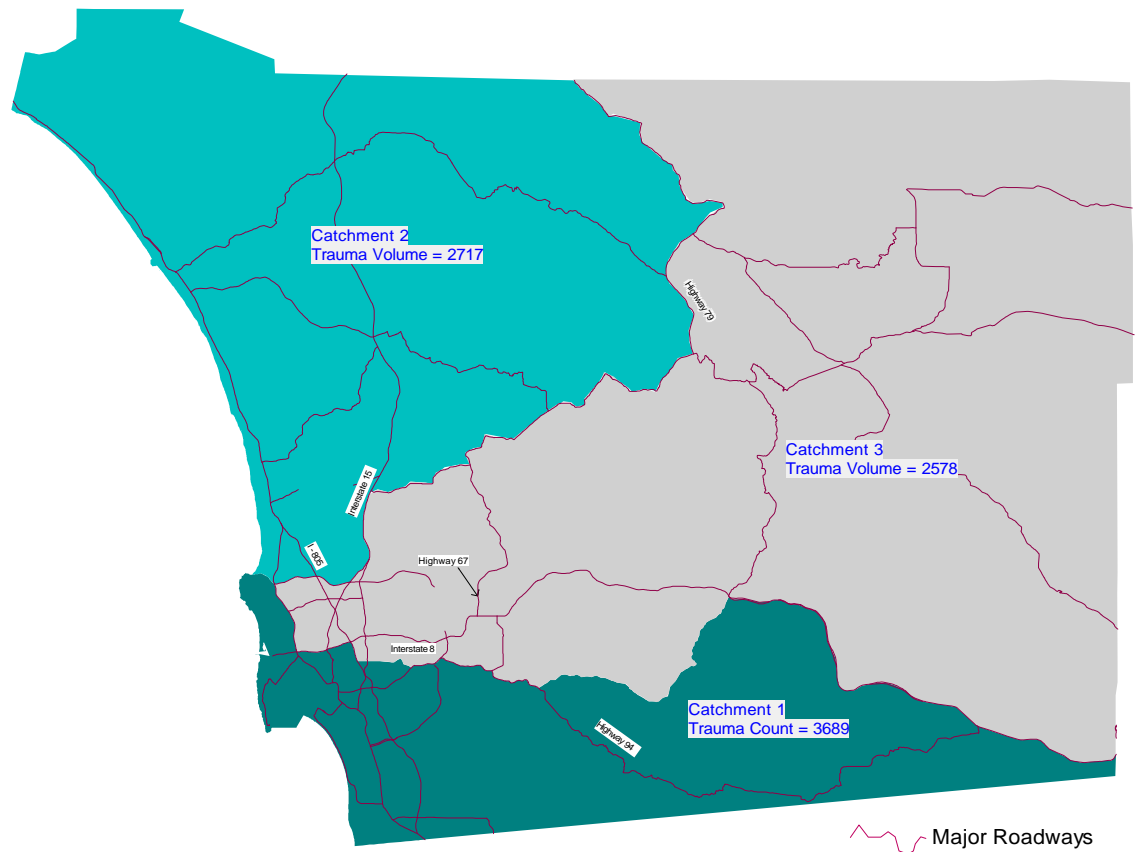


Source: SANDAG, SDEMSA and The Abaris Group



This map shows what the catchment areas might look like if two hospitals dropped out of the San Diego County trauma system. Obviously, the estimated trauma volume at the remaining centers reaches overwhelming proportions. The trauma transport numbers were obtained from the FY00 Prehospital Database and then proportionately adjusted to reflect trauma arrivals.

Exhibit 53 - Effect of Two Trauma Centers Leaving the San Diego County Trauma System



Source: SANDAG, SDEMSA and The Abaris Group



Population-Based Trauma Study

The Abaris Group analyzed hospital discharges by injury severity score (ISS) score using ICDMAP-90 software. This method has been described by MacKenzie and validated in the literature as a tool to investigate trauma system from a population standpoint.⁴⁴ This method uses hospital discharge data ICD codes to map to injury severity scores (ISS). While the method is not perfect, it is a way for conducting population studies on trauma case destination and severity. The MacKenzie study confirmed that there was a reasonable match using the ICDMap-90 software to actual chart coding.

Patient discharge data was obtained from the Office of Statewide Health Planning and Development (OSHPD) California Patient Discharge Data for 2000. The OSHPD data were uniquely identified for each patient, thus eliminating double counting. The ICDMAP-90 software was developed by the Center for Injury Research & Policy of the Johns Hopkins University Bloomberg School of Public Health. ICDMAP-90 translates the ICD-9 injury codes from the OSHPD inpatient discharge data into an ISS score for hospital.

A total of 5,794 patients had an ISS of 9 or greater, of which 3,561 (61.5 percent) were treated at trauma centers. 85 percent of the major trauma, or those patients with an ISS score greater than 15, were treated at trauma center facilities.

Careful use of this data is important. The data come from discharge data and include patients from EMS transports who may have or may not have initially met trauma

center standards but subsequently were discharged with ICD codes that mapped with a 9 or greater ISS. Some of these patients may have had injuries so severe (e.g. respiratory arrest) that the trauma patient could not be transported to a trauma center. Some of these patients may have been transported to the non-trauma center by private vehicle. The computer model may not also control for other injury conditions that mimic trauma center patients (e.g. a patient with a high ISS score but that did not meet the trauma center criteria such as an elderly hip fracture). However, there is the potential for this data to demonstrate some level of under-triage and the data may be useful to further triage studies as well.

A review of this data compared to other trauma discharge data studies demonstrated excellent capture by the trauma centers for trauma patients. A comparison of this data to a previous study conducted by Dr. John Udell, Trauma Coordinator, State of New Mexico, indicates that this 2000 year data closely matches his 1998 San Diego data and other better practice trauma systems in the country. Dr. Udell has conducted 40 of these discharge dataset studies nationwide.

44 MacKenzie EJ, Steinwachs DM, Shankar B. Classifying Trauma Severity Based on Hospital Discharge Diagnoses: Validation of an ICD-9CM to AIS-85 Conversion Table. *Med Care* 1989 Apr;27(4):412-22.



Exhibit 54 - Distribution of Trauma Among Hospitals

Moderate to Major Trauma Distribution for San Diego County Hospitals (based on ICDMAP-90 ISS calculations)

San Diego Hospitals	Moderate Trauma ICD-ISS 9 to 15	Percent of Moderate	Major Trauma ICD-ISS > 15	Percent of Major	Facility Total	Percent of Total
Non Trauma Centers						
Mesa Vista Hospital	-	0.0%	-	0.0%	-	0.0%
Villa View Community Hospital	5	0.1%	-	0.0%	5	0.1%
Scripps Hospital - East County	21	0.5%	1	0.1%	22	0.4%
Sharp Coronado Hospital & Healthcare Ctr	39	0.9%	9	0.6%	48	0.8%
UCSD/La Jolla - Thornton Hospital	51	1.2%	2	0.1%	53	0.9%
Paradise Valley Hospital	65	1.5%	7	0.5%	72	1.2%
Scripps Memorial Hospital - Chula Vista	69	1.6%	7	0.5%	76	1.3%
Sharp Cabrillo Hospital	69	1.6%	9	0.6%	78	1.3%
Fallbrook Hospital District	73	1.7%	4	0.3%	77	1.3%
Scripps Memorial Hospital - Encinitas	91	2.1%	10	0.7%	101	1.7%
Sharp Chula Vista Medical Center	100	2.3%	12	0.8%	112	1.9%
Scripps Green Hospital	118	2.7%	12	0.8%	130	2.2%
Pomerado Hospital	163	3.7%	8	0.6%	171	3.0%
Alvarado Hospital Medical Center	182	4.2%	25	1.7%	207	3.6%
Grossmont Hospital	232	5.3%	30	2.1%	262	4.5%
Tri-City Medical Center	365	8.4%	32	2.2%	397	6.9%
Kaiser Foundation Hosp - San Diego	377	8.7%	45	3.1%	422	7.3%
Non Trauma Centers Sub Total	2,020	46.4%	213	14.8%	2,233	38.5%
Trauma Centers						
Children's Hospital - San Diego	203	4.7%	129	9.0%	332	5.7%
Palomar Medical Center	441	10.1%	206	14.3%	647	11.2%
Scripps Mercy Hospital	434	10.0%	219	15.2%	653	11.3%
Scripps Memorial Hospital - La Jolla	382	8.8%	255	17.7%	637	11.0%
Sharp Memorial Hospital	524	12.0%	216	15.0%	740	12.8%
UCSD	350	8.0%	202	14.0%	552	9.5%
Trauma Centers Sub Total	2,334	53.6%	1,227	85.2%	3,561	61.5%
Grand Total	4,354	-	1,440	-	5,794	-

Source: OSHPD California Patient Discharge Data, 2000 & ICDMAP-90 Software, Center for Injury Research & Policy of the Johns Hopkins University Bloomberg School of Public Health.



Trauma Center Funding Comparison Study

Introduction

Providing a stable source of funding for trauma centers has been an ongoing issue since the early development of trauma systems in the country. Changes in funding sources, particularly insurance payers, have created instability over the years.^{45, 46, 47}

Improving revenue cycle management and payer contracting has helped, but in some communities these efforts have not been substantial enough to stabilize their trauma system.

In this section, The Abaris Group provides an overview of identified funding sources for trauma care.

State Funding Sources

Many states provide funding for the administration of their state's trauma system at the state level. However, there are only four states that provide ongoing funding to support their trauma centers: Illinois, Mississippi, Oklahoma, and Washington. California has a one time funding program that expires in 2003.

Arizona

During November 2002 the state voted to approve doubling the state's tobacco tax on cigarettes to \$1.18 a pack and use the \$150 million strictly for the trauma centers. The measure passed two to one. The details on the expenditures are still being worked out in the state.

California

During the 2001 legislative session, the California Legislature passed AB1430, The

Trauma Fund Act, which encouraged the development of a statewide network of trauma centers and established a one time source of funds for trauma centers in the state. The \$20 million allocated from this bill was renewed during 2002 and will provide support to the trauma centers through 2003. The funding is allocated on a fixed and volume basis. Each trauma center received a fixed amount according to their designation level (e.g. \$150,000) and then an allocation based on volume of patients as determined by the trauma registry entries. San Diego County trauma centers received \$4.9 million for FY 2002 and will receive another \$2.7 million for FY 2003.

Illinois

The State of Illinois established a fund for uncompensated trauma care in 1993. The funding derives comes from a \$5 fee placed on every moving violation over \$55. In 1994 a \$30 fine from each DUI conviction or order of suspension was added. Since 1993, they have expended approximately \$20.4 million. The amount of funding each hospital receives depends on the number of trauma patients treated. Additionally, funding is provided to those hospitals that care for Medicaid trauma patients. There is no funding for physicians.

Mississippi

In 1998 the State of Mississippi began allocating between \$8.0 – 8.5 million annually for uncompensated trauma care. The funds come from revenue generated by Mississippi's Tobacco Settlement principal (\$6.0 million) and from moving traffic violations (\$2.5 million). There are seven trauma regions, each receiving \$85,000 thousand for administration purposes. The remaining portion is divided among participating hospitals and surgeons

45 Trauma Care: Saving Lives Despite Setbacks, Zoller, M. Medical World News, June 1988.

46 Trauma Collapse, Can the system be saved?, Williams, MJ. California Hospitals, October 1999.

47 Trauma Care: "Lifesaving System Threatened by Unreimbursed Costs and Other Factors", GAO, May 1991.



(orthopedic, general and neuro). In addition, Level IV trauma centers that transfer a trauma patient also receive 20 percent of the reimbursable amount. In order to receive compensation, the patient must meet the trauma criteria and not have any ability to pay the charges.

Oklahoma

The State of Oklahoma's uncompensated trauma care fund was established in 1999. It is generated from a \$1 per person driver's license renewal fee. The fund's balance is \$2.6 million, with 10 percent going to the Department of Health for administration of the trauma system and the remainder divided among trauma centers and prehospital providers. There is no compensation for physicians.

Washington

In 1997 the State of Washington passed a law creating the Trauma Fund to provide funding for uncompensated trauma care. The Trauma Fund expends approximately \$31.0 million every two years. The funds are generated from a surcharge on motor vehicle infractions (\$5 of every fine) and the licensing of new and used vehicles (\$4 per vehicle). The sources generate roughly \$30 million annually. The remaining \$8.0 million comes from federal Medicaid matching funds. To qualify for reimbursement the patient must have an Injury Severity Score (ISS) of 9 or greater and be eligible for medical assistance (Medicaid). The State provides funding for prehospital providers, hospitals, physicians and rehabilitation facilities. The state hired Arthur Anderson in 1992 to help them determine the level of uncompensated care. Washington has a relatively stable state trauma fund. Some funds go to trauma centers, with extra going to those treating DHS patients (through participation grants), plus additional reimbursement for patients with a specific ISS.

Other Public Funding

Alameda County, CA

Alameda County has a special EMS and trauma tax district called the Alameda County EMS District. It was formed in the mid 1980s to support EMS providers and to develop the trauma system. The fund assesses all parcels at \$23.94 per parcel. The trauma portion of that equates to about \$8 per parcel. The fund was established for the EMS Agency, EMS providers and the trauma centers (2 adult and 1 pediatric trauma centers). The trauma centers are subsidized approximately \$10 million per year based on uncompensated care. The tax was developed under the Special Benefit Assessment District law of California that allowed the Board of Supervisors or the electorate to provide a simple majority for approval of these assessments. The County chose to obtain voter approval, and it was approved by in excess of 80 percent of the voters. When the Benefit Assessment statute was overturned five years ago, the Tax District was re-voted on with another landslide approval percentage. The EMS Agency is called "The EMS District" and it controls all funds which have been authorized for the District. (San Diego has approximately 885,000 parcels. A similar trauma tax at \$8 per parcel would generate approximately \$7.1 million per year.)

Los Angeles County, CA

Los Angeles County has funded trauma centers for nearly 15 years through a combination of general fund and tobacco tax funds. The reduction of tobacco tax dollars over recent years put the trauma network in crises and that plus serious County budget shortfalls put the entire Los Angeles County public hospital system at risk. A ballot measure introduced to provide for \$168 million in funding was approved by a 73 percent vote in November 2002. Mea-



sure B raised property taxes by three cents, or about \$42 for a 1,400 square foot home. In addition to funding trauma centers and emergency departments the money was proposed to be used for bio-terrorism. The funding is going to be heavily used to stave off the closing of Harbor-UCLA Medical Center, a Level I trauma center, and Olive View-UCLA Medical Center, an acute care hospital. There is some hope that these funds will help entice hospitals that used to be trauma centers in the Pomona and Antelope Valleys to come back in as trauma centers. There are three public (LA County Department of Health) and ten private trauma centers in the county. It is not clear how much of these funds will be available to support the private trauma centers once the public hospital needs are met. This was the first countywide increase in property taxes in Los Angeles County since 1978.

Palm Beach County, FL

The Palm Beach County, Florida funding mechanism is an independent taxing district authorized through the state for Palm Beach County. The tax district charges a property tax of about \$1 per \$1,000 assessed value. It generates over \$100 million in revenue annually, with \$24 million budgeted for trauma. The remaining funds go to other indigent care, school nurses in the public schools, etc. Of the \$24 million budgeted for trauma, two trauma centers each receive \$6 million per year, with on-call physicians receiving about \$8 million and an air medical program taking up the balance. Funding to the hospitals has remained fairly static. The funds had been allocated to the trauma hospitals in grants, but currently the County is using a formula based on percentage of uncompensated charges. In addition to paying for on-call coverage, the fund also pays some malpractice insurance costs for the trauma physicians.

Other Initiatives

There are other trauma funding tax activities in Florida. Dade County uses a half cent sales tax to fund their one trauma center. Broward County has two taxing districts for funding indigent care including the indigent care for trauma center patients. The tax revenue goes to reimbursing hospitals and their physicians for trauma care at Medicare rates. Lee County, FL authorities proposed a trauma center sales tax to raise \$35 million for their single trauma center and multiple emergency departments but the initiative failed. Five million was earmarked for the trauma center. 57 percent of the voters voted against the measure.

San Diego County has electively chosen to prioritize the use funds from traffic fine surcharges (SB12/612) and other sources (Maddy Fund) to support the trauma centers. The total annual allocation from these funds ranges from \$120,000 to \$300,000 per year depending on revenue from the funds.

California has under taken several other emergency department and trauma center funding activities. Approximately one year ago Senator Gloria Romero (D-Los Angeles) proposed a “nickel a drink” tax (SB108) to support the emergency departments and trauma systems in the state. This bill would provide a fund to pay for expenses for “alcohol-related” emergency room and trauma center care. The bill has been heard at the state level several times but is not expected to move quickly due to State budget constraints. During February 2003, the Los Angeles County Board of Supervisors voted to ask the State Legislature for permission to levy a similar alcohol tax in the county. A California Medical Society and California Healthcare Association initiative two years ago, designed to develop a ballot measure to fund the emergency department and trauma center network in the state failed to



achieve sufficient voter interest to justify continued pursuit by these organizations.

Other Potential Sources

Existing General Revenue and/or Federal Funds

Consideration has been given by some for direct funding for the state's trauma center network through existing general revenue. Los Angeles has provided modest funding for their trauma centers through their general fund but has indicated this funding cannot continue. There is no county budget in California that is not significantly strained and capable of allocating significant funds for new purposes such as the trauma networks in their communities.

Surcharges

Another approach would entail increasing or adding surcharges or fees to products or activities that frequently contribute to the need for trauma care services. Consideration of adding additional surcharges for traffic fines is a challenge in the state as the courts levying such fines have indicated they are not willing to add to the surcharges or to see those funds go outside the criminal justice system.

Some states (Oregon, Washington) have attached surcharges to the fee for each motor vehicle license registration issued in the state, including motorcycles. Automobile collisions are growing as the number of miles traveled annually increases. Similar proposals in other states have added a \$5 surcharge on motor vehicle registrations, with estimates that this would generate an estimated \$100 to \$150 million per year. Another source in California would be to increase the fee for driver license/ID issuance and renewal. This concept is similar to the vehicle license fee and would be to increase the fee to obtain or renew an identification and/or a license to operate a motor ve-

hicle, including motorcycles. The challenge to this concept is that it is already being pursued in the State budget as a funding measure to close the budget gap. Another option is to establish a surcharge to automobile insurance policies. Consider adding a surcharge on each automobile insurance policy issued in California. Pennsylvania has implemented this approach to supplement funding. There is the concern of insurance companies supporting an addition to the already expensive insurance premiums in California. Another consideration is to require automobile insurance policies to provide \$50,000 in personal injury protection for trauma care, with the auto policy coverage paying the trauma center costs first, and health insurance being a secondary payer. This is common practice in some states (Connecticut and Oregon) with higher than average health coverage on their auto policies and state statutes that require the auto insurance policy to be the first source of payment for auto collision injuries.

Another option is to provide an assessment on the illegal discharge and/or sale of firearms and ammunition. The State of Illinois has in the past introduced legislation to levy a fine on the illegal discharge of firearms and add a tax to the sale of firearms, which in 1997 would have resulted in \$5 million in annual revenue. Such fines and taxes were proposed in an effort to offset trauma costs associated with violent crimes. There is a significant gun lobby that would need to be overcome for this concept to be successful.

Another concept would be to add to the 9-1-1 surcharge on phone bills in the state. This is a potent revenue source as the number of telephone lines and cell phones in the state is increasing rapidly. There is currently a surcharge on telephone bills to fund the 9-1-1 system. This approach has been attempted in California a number of times and has been rejected due to significant public safety concerns of the inappropriate use of the 9-1-1 surcharge for non public safety reasons.



V. Conclusions and Recommendations

Acute Trauma Care

The six trauma centers provide the bulk of the acute care delivery system in the county and are really the center of excellence for the trauma system. The Abaris Group's review of the trauma centers concluded that the trauma centers operate at a best-practice level with respect to their capabilities, commitment and unrelenting focus on quality. The commitment alone is worth mentioning, as it permeates the executive leadership, medical staff and trauma care providers.

The quality of trauma care and execution of the function of trauma center supervision at the County level are both exceptional. The community of San Diego should be comforted and proud of their industry-leading trauma delivery system. Trauma center operations exhibit their quality as a function of the above factors and the dedication and resources of the trauma management team.

There are no significant immediate recommendations for trauma acute care or for the trauma center criteria. Two modest recommendations are made as follows:

- *Trauma Program Manager Position.* It was noted by The Abaris Group that the trauma program manager position is not consistently staffed at a full-time trauma manager level at each trauma center. There have been times when this has been a rate-limiting factor for the trauma system. The Abaris Group recommends that the County establish the trauma program manager position as a full-time requirement within the trauma center standards.
- *Trauma Physician Staffing.* The trauma centers will continue to be challenged with trauma physician staffing issues

fueled by the limited number of physicians, declining interests in serving trauma centers and EDs and physician life-style needs. The trauma centers must work individually and collectively to identify future needs and match those needs to creative strategies. These strategies may include adjustments to the triage standards, improved control of non-trauma patient consultative transfers to the trauma centers, care pathways at the trauma centers to reduce unnecessary utilization of key specialists and developing ways to leverage the skills of other practitioners to reduce key specialist workload (e.g. nurse practitioners, specialized hospitalist programs, etc).

“The Abaris Group’s review of the trauma centers concluded that the trauma centers operate at a best-practice level with respect to their capabilities, commitment and unrelenting focus on quality.”



“There is a role for both event and process components in a quality improvement effort for a mature trauma system such as San Diego.”

Trauma Quality Improvement

Without question, the trauma quality review process is the single most important strength of the trauma system and many positive conclusions have been drawn in this report about this process. As in any complex and resource-intensive process of integrity, there are opportunities for refinement. Although the quality review process has been refined from its initial burdensome formula, it cannot be called a true quality improvement process, but rather a medical audit or event process. Much of the work of MAC verifies the high level of clinical performance of the San Diego trauma centers but verifies little of the overall exceptional operational, cost and system performances which were evident during The Abaris Group trauma center reviews. In addition, there is little justification to continue some portions of this process which yield scant returns and there is much to be gained by efforts in the latter mentioned areas.

There is a role for both event and process components in a quality improvement effort for a mature trauma system such as San Diego. An important feature of the MAC process, the collegial atmosphere and relationships which exist among the trauma centers, should not be lost in any fine tuning of the MAC process. In addition, all modifications should serve to strengthen the hospital/County partnership.

Some suggested refinements include:

- *Outlier Review.* Discontinue circulation of “non-outliers” during the Pre-MAC process, thereby reducing the time burden on the trauma directors. The trauma medical directors should be encouraged to include dictation on cases of interest or those having particular educational merit.
- *System Data.* Begin to consider specific system issues derived from the County data set. Any trauma center should be able to request trended data on given injuries, injury mechanisms, prehospital protocols and the like without complex approval processes and access issues.
- *Benchmarks.* The potential to create benchmarks is a supportable activity. This can be accomplished on clinical, process, and financial topics. Sharing the data between trauma centers would also create healthy competition. This alone may be an effective way to leverage performance review.
- *Prehospital.* Methods to close the gap between the trauma system and prehospital system should be initiated. A quarterly educational forum, open to prehospital and hospital participants, could be developed and cases of merit from MAC could be presented in a grand rounds format. This might be titled the “San Diego County Trauma Rounds.” This would involve a larger group of stakeholders (larger than MAC participants) and might include noteworthy cases, pitfalls in triage decision making, etc., but would allow a wider audience to be exposed to the excellence in care. It would dovetail nicely with a marketing recommendation to promote the trauma system, which is made later in these recommendations. This could also force a system-wide focus on the care of the patient from response, field care, resuscitation, hospital care, etc. It would also provide an opportunity for enhanced relationships among hospitals and prehospital agencies and provide at least one additional mechanism for feedback to prehospital providers. The County could be asked to provide data on the system’s performance based on system audit filters. This would require a more current data management



system and process. It would allow the MAC participants to utilize their knowledge to trend issues and improve the system in the same way they refine and improve their trauma services and clinical care approaches.

- *Strategic Initiatives.* There are important trended and strategic considerations for the San Diego trauma system. More strategic emphasis should be placed on a system performance review process with MAC in a leadership position for that role. Through strategic planning, the trauma community would begin to identify system trends and needs that should be studied and developed through the MAC process. These might include care pathways, cost reduction efforts, improved system coordination, improved efficiency and integrity of the data collection process, triage and outcome studies, strategic planning for volume changes, scenarios for resource changes (e.g. number of orthopedic surgeons), and system-wide changes (e.g. if a trauma center terminated their designation) and other issues of system-wide significance that are largely not explored today. This would slightly alter MAC's role from nearly 100 percent event-based review to a balance of event and system issues, but it would bring the quality review process more in-line with contemporary process improvement practices.
 - *Data Security and Reporting.* Initiatives should be developed to build a higher confidence level with the EMS Agency, its data acquisition, security and appropriate work on system reporting and trending. For example, the EMS Agency should explain the security measures they follow to protect the Pre-MAC binders. There are significant delays in achieving trauma reporting due to certain practices and policies at
- the trauma center and County levels. A full exploration of this issue is needed.
- *Annual Trauma Center Audit.* The Abaris Group recommends moving the comprehensive annual audit to every three years. The current annual audit is resource-intensive and does not appear to create substantial yield. The County is also experimenting with a self-reported audit this year. The three-year ACS review is an important ongoing vehicle for quality review and should not be abandoned. It is therefore recommended that the trauma centers continue their EMS Agency review process but that it be annual and self-reporting and the onsite EMS Agency audit portion be blended into a three-year ACS review.
 - *EMS Agency Review.* The EMS Agency should also be subject to a three-year review that connects to the approved vision, deliverables and other trauma system expectations collaboratively developed as part of the strategic initiative process.
 - *Trauma Designation Fees.* The Abaris Group recommends eliminating the trauma center designation fee as a gesture of good faith to further the trauma system partnership as described under Leadership below. Trauma system stakeholders should look to assisting the County in reducing or offsetting their costs by supporting the reducing audit role, reducing unnecessary work on the trauma registry (redundant verifications) and reduction of their duplicative roles at Pre-MAC and MAC.



Trauma Triage

San Diego's trauma triage standards follow national criteria but have not been comprehensively studied and customized for local conditions, resource consumption and patient outcome. The San Diego trauma system faces numerous challenges to its financial viability and a high rate of over-triage may be taxing the resources of the system. While not apparent in San Diego, some communities with non-trauma hospitals perceive that high rates of over-triage threatens their viability as well. The widening funding gap for trauma systems will eventually require an alignment of appropriate resources for appropriate patients.

“The San Diego trauma system should conduct a quantitative analysis of its trauma triage criteria using the rigors of a publishable study.”

- *Quantitative Analysis.* The San Diego trauma system should conduct a quantitative analysis of its trauma triage criteria using the rigors of a publishable study. The clinical, financial and legal implications of a trauma system make it important for a thorough quantitative examination of the effects and impact of triage policies within a given trauma system. San Diego's trauma system has the data collection capability, if properly linked, to conduct such a study.
- *Patient Definition.* As this report documents, there are significant limitations to the patient definitions used in current San Diego data sources (QANet, the Trauma Registry, and hospital discharge data). The registry or any special study database will require more inclusive criteria to assure ED discharges and other trauma patients are properly studied as part of the triage analysis.
- *Linked Databases.* The ability to link field and trauma registry data exists but is not currently used to the extent that it could be useful to a triage study. This linkage and compliance with data entry should be established for the triage study.
- *Triage Decision Points.* The decision-making process cannot be verified along the points of the care continuum as there is no documentation of the criterion used to make triage decisions. There should be clear delineations of the trigger criteria for defining trauma patients and this documentation should be included in the prehospital care data and with the QANet.



Trauma Prevention

Injury prevention is a high priority for the San Diego community and the trauma network. There are, however, opportunities to refine and to more clearly target trauma system prevention priorities. Trauma prevention recommendations are as follows:

- *Injury Prevention Clearinghouse.* San Diego should develop an injury prevention center/clearinghouse that works collaboratively with the trauma centers and community organizations. One entity that would lend itself to this role is TREF. The clearinghouse could serve as a neutral recipient of grants and operate as an information resource for injury prevention information, programs, and assistance to the trauma centers. This clearinghouse should also identify opportunities for improving communication on all injury prevention programs. For example, establishing a web site in collaboration with the trauma centers and other agencies providing injury prevention programs would be a valuable resource. TREF has an existing web site that might be a possible springboard toward achieving this goal.
- *Trauma System Prevention Targets.* To pursue the goal of targeted trauma system prevention, it is important for the “system” to agree that one or more prevention programs should be driven based on trauma patient epidemiology either from the standpoint of targeted high-risk patients or yield. This would include conducting an annual evaluation of the trauma system data in order to identify trauma center trends within the community and coming to consensus on the targets. The County EMS Agency should take the lead on this identification process.
- *Targeted Program Implementation.* Implementing trauma system programs driven by registry data may create a yield for existing programs that are modified for that targeted purpose or new programs that could be created. The key is global trauma system participation. TREF continues to be an obvious source for this implementation effort.
- *Funding Sources.* Identifying a stable and secure funding source for trauma system injury prevention is a likely activity to be directed to TREF and the San Diego County EMS Agency to support the functions listed above.



Trauma Registry

Significant emphasis is placed in the San Diego trauma system on data collection and data integrity. While there are strengths to the current San Diego trauma registry system, there are roadblocks to making it the most effective and efficient information system for the future. The recommendations on the trauma registry are as follows:

- *Creation/Acquisition of a Single Robust Trauma Registry.* The Abaris Group finds there are major limitations with the use of two registries in a contemporary trauma system. Clearly the Dales Registry has provided a high quality product for many years to the trauma system. Not unlike the County's bubble form, the registry has limitations and lacks the capability to integrate with other information systems and complete the required reporting functions that will be necessary for a contemporary trauma system in the future. There is also the ongoing work at the County level and at the various trauma centers in "making the software work" as it relates to reporting and the interfaces required to integrate the two databases. The Dales Registry by definition is an aging product without clear indication that it will have the resources to undertake what will eventually be a necessary significant overhaul.
- *System Trauma Registry Expectations.* It is important for trauma system participants to define ongoing and future trauma information needs and to better define the expected role of the trauma registry. Examples of future needs may include trend analysis, case management, more precise epidemiological factors, expanded outcome parameters (e.g., triage algorithm), and financial components of the trauma system. There is also an ongoing need to document the

system's effectiveness. Should all or some of these parameters and applications be important to the trauma system, then the trauma registry should be so adjusted.

- *Future Integration.* The County has the trauma registry integration resources and has retained a company, Digital Innovations, to update and integrate the QANet. This activity may represent a timely opportunity for the trauma system to completely reevaluate trauma registry and integrate it into the prehospital and EMS Agency information system to ensure seamless integration of their information systems with other EMS and healthcare resources.



Prehospital

San Diego County's prehospital care program as a component of the trauma system represents a national best practice EMS delivery system in terms of capabilities, coverage and performance. It is because of the prehospital care system (EMS providers, ground and air ambulance, and base hospitals) that an at-risk injured trauma patient is consistently transported to a trauma center.

The following are The Abaris Group's recommendations to enhance the prehospital care system's role and integration with the trauma system.

- *Prehospital Information System.* The current process to re-engineer the prehospital care information system should be reinforced as a high system priority to assure relevance, functionality and timeliness. The current process is manual, labor intensive, and redundant. The processes that are used to develop information are slow and thus irrelevant to the providers for daily management needs. Data scanning at the County level is consistently 18 months behind schedule with many contributing factors. Some providers have been forced to create redundant systems to meet their information needs. While there is a significant effort to re-engineer this system, it is not clear that the information distribution system at the County level will improve as a function of that process.
- *Linked Injury Data.* Data on injured patients should be linked from 9-1-1/PSAP dispatch to the field patient care report, trauma registry and patient outcome. This will make it possible to conduct geographic, care pathway and system outcome analyses on the trauma system. Other system parameters and sentinel events need to be clearly defined.
- *Off-line Medical Control.* The Abaris Group recommends reinforcing the current effort to move to more off-line medical control and data driven protocols. The Abaris Group acknowledges the current direction of that movement but recommends accelerating the pace and deliverables perhaps through the development of a separate workgroup for that purpose. This would allow the county to make a speedy transition to evidence-based protocols. Caution should be exercised to assure that the quality control system data is in place to carefully measure the impact on the new protocols. Once implemented, this would mean a substantive change in the role of the MICN and base hospital but their role would still be important for education and proper system feedback.
- *Catchment Zones.* MAC and the San Diego County EMS Agency should revisit the catchment zones as requested by the City of San Diego. Their concerns may be legitimate and the initial analysis by The Abaris Group on volume impact to the trauma centers suggests a minimal impact from changing the zones.
- *Linkage with Trauma System.* Improved linkages between prehospital care and the trauma system are needed. There are gaps between the true integration of the prehospital care component of EMS in San Diego and the trauma system. These gaps are largely input/feedback, educational, and trauma policy involvement. As indicated under the MAC recommendations and reinforced here, a global (through TREF) or rotating prehospital grand round session should occur quarterly hosted by the trauma centers. On the other triage and catchment zone recommendations in this report, the recommendations assume substantial EMS input.



“None of those who expressed an opinion about the need for more trauma centers could rectify the recognized financial, volume and commitment issues that would surface with increasing the number

Trauma Center Configuration

The scope of this study required The Abaris Group to provide an assessment of trauma center configuration should there be a trauma center reduction for any reason. A baseline needs assessment on the number or location of trauma centers was not required within the scope of this study, however, there was substantial input provided during this study on this topic.

- *Adding Trauma Centers.* Adding trauma centers in the current system is not a viable option. Much was said during the interviews by prehospital and hospital representatives outside the trauma centers about the need for increased numbers and improved locations for the trauma centers in the county. For the prehospital staff, this is purely about improving perceived access. There was a clear bias by these interviewees encouraging more trauma centers in the north, south and east parts of the county depending on the geographic orientation of the interviewee. None of those who expressed an opinion about the need for more trauma centers could rectify the necessary financial, volume and commitment issues that would surface with increasing the number of trauma centers.
- *Reducing the Number of Trauma Centers.* The current location of trauma centers are justified by volume, proximity to where injury occurs and the existing trauma center depth of commitment and experience. There is also a need to establish sufficient numbers of trauma centers to assure depth of coverage for major incidents and potential terrorist activities. A segment of non-trauma center representatives interviewed and to a lesser extent some trauma center representatives expressed opinions that there were too

many trauma centers and those that existed were geographically misaligned (e.g. too many trauma centers in the core of the county, insufficient numbers in the outer areas). These interviewees also could not rectify the importance of the institutional commitment, experience and clinical excellence of the existing trauma centers and the risk that reconfiguration might have on diluting these important attributes. It is a fact that most of the trauma cases occur in or near the downtown area of the county. Those interviewed admitted that the use of ground and particularly air-medical services reduced their concerns but did not eliminate them due to weather and other transport limitations.

- *Current Trauma Volumes.* The trauma centers have the volume to support operations and clinical effectiveness. The Abaris Group evaluated volume (current and projected) at each trauma center and for the system as a whole. While there are recommendations in this report on evaluating triage criteria, the current volumes at each trauma center meet or exceed The Abaris Group's minimum standard of 1,200 trauma arrivals per year for clinical and financial efficacy. The Abaris Group has also predicted a modest growth in trauma center volume, thus enhancing the existing volume. Even with these projections, The Abaris Group does not predict the need for another trauma center in the near future.
- *Blend of Quality and Resource Availability.* The Abaris Group has concluded, based on the current operating policies and assumptions of the San Diego trauma system, that the existing trauma center configuration (number and location) represents the best blend of quality and available resources matching the volume of cases. Therefore The Abaris Group does not recom-



mend changes to the trauma center configuration.

- *Unexpected Reduction.* The reduction of one trauma center would not collapse the resources of the trauma network but may strain these resources and have other unexpected impacts. The loss of two trauma centers would significantly tax the trauma network. The Abaris Group has provided some scenarios and analysis in this report should there be a reduction in the number of trauma centers. The Abaris Group's conclusion is that the loss of one trauma center would tax prehospital resources and the surviving trauma centers but there would be adjustments to system resources that could resolve the impact without adding an additional trauma center. Should two trauma centers withdraw from the system, it is not likely that a replacement trauma center at the level of commitment and experience required would be available. Therefore, the trauma stakeholders would need to look at reconfiguring the system for four trauma centers. This would include evaluating the trauma triage standards, developing a single index case (complex cases) trauma center (e.g. freestanding Level I with dedicated resuscitation, OR and intensive care beds) such as has been done in a few metropolitan centers in the country, developing a network of Level III centers and/or a combination of these efforts. These "what if" scenarios should be further developed in a strategic planning process by the County EMS Agency in concert with the trauma centers.



“The new environment recommended for the system will take San Diego County’s credible trauma system to the next level via creating a shared vision and set of expectations.”

Leadership

As stated before, there is outstanding leadership at the trauma center level. The County’s historical commitment to the trauma centers and their leadership in developing trauma systems elsewhere in the country should be recognized. The County’s ongoing leadership with the trauma system is clear with the authorization of this study and the many other EMS system design improvement efforts planned or underway. The lack of controversial system issues is also an indication of a well designed, collaborative and supervised system. There is clearly a different and more positive collaborative tone of cooperation between the trauma centers and the County than in other California trauma systems where the relationships tend to be characterized by a “buyer/seller” relationship.

All trauma system stakeholders expressed a desire to continue to mature the County and trauma center relationship into a true partnership. There is also a need to continue the strategic analysis work begun by this study to assure a future sustainable quality trauma system. The barriers to accomplishing this goal are access to resources at the County level, robust information systems, a mature partnership relationship between the County and the trauma centers, and an empowered strategic leadership role at the County level. Changes to the leadership assumptions and resources will be needed to accomplish this.

The new environment recommended for the system will take San Diego County’s credible trauma system to the next level via creating a shared vision and set of expectations. This will require clarity of purpose, empowerment and the resources to accomplish the mission. The trauma centers need to further develop their shared view on “partnership” such that it has few limitations to achieving the shared vision. The County will need to identify

appropriate resources and allocate them to achieve this goal. This will be particularly challenging but not impossible at the County level now that the County is experiencing the pressures of the State budget deficit.

The Abaris Group’s leadership recommendations are as follows.

- *Defining Expectations.* There is considerable variation between the provider expectations of the County and the County of itself. There is a need to collaboratively define strategic “leadership” expectations and deliverables from the County. This can be accomplished through the strategic planning process.
- *Linked Information System.* There is a need to develop a linked information system that allows a complete assessment of trauma care from injury to outcome. There should be clarity of purpose and integrity of the process. However, artificial limitations to use data should be eliminated. This commitment cannot be understated and is critical to continuing the ongoing confidences of system and center performance and effectiveness.
- *Strategic Planning.* Trauma system stakeholders should collaboratively create a strategic vision of what the “partnership” role means between the County and all trauma stakeholders. This process should include envisioning the future direction and priorities of the trauma system in general. This is likely to require a number of sessions and outside facilitation. Key potential topic areas have been previously mentioned in this report, but one additional target should include consideration of the excessive use of trauma center resources through non-trauma center ED transfers.



- *Resources.* As part of this process a realistic look at resources and empowerment tools at the County level is needed to allow the vision and deliverables to occur. The visioning process will drive the resource needs which should include a realistic look at current workload and priorities at the County level and access to additional resources should the partnership require this. This will take significant consideration and priority setting by the County, particularly in the face of budget constraints.
- *Epidemiologist and Surveillance Function.* Even prior to the conclusion of the strategic planning process there is a need by the County to begin to reaffirm priorities and resource allocation for the County's epidemiology and surveillance team. The blend between meeting priority needs, resources and developing a friendly but cost-effective information management and reporting system is important to this consideration. There are clear targets recommended in this report (e.g. triage study, trending, and report publication) that should be taken into account and melded with the other EMS system and injury prevention needs with the short- and medium-term plans of these staff.
- *Implementing Initiatives.* In partnership, the County and trauma stakeholders should continue to implement and refine strategic initiatives based on the developed strategic vision/plan. This should be done with the development of an action plan, time defined deliverables and performance measures.



“Creating a stable and sustainable funding source for the trauma system is a critical need. This funding is needed at the trauma center and system leadership levels (EMS Agency).”

Fiscal Planning

The cost of trauma care and the technology needed to meet the complex needs of the trauma patient continue to rise. Current revenue sources for trauma patients are fragile and constantly at risk. Creating a stable and sustainable funding source for the trauma system is a critical need. This funding is needed at the trauma center and system leadership levels (EMS Agency).

The Abaris Group’s study of operations at each trauma center concluded that the trauma centers are at best practice as it relates to trauma center cost controls, and while more could be done to optimize costs (e.g. system-wide clinical pathways), such efforts would likely only achieve nominal effects. The Abaris Group also identified that there are better and best practices in place at the trauma centers on revenue cycle management. The cost and revenue facts are largely the reason that San Diego County’s trauma system has been as stable as it has been for the past 18 years. Recent subsidization of the trauma centers through State and local funds has also helped, but this funding has been nominal and much of those funds are onetime sources.

There are very limited areas in the country where publicly supported dollars are used for trauma centers. Those that do exist (e.g. Alameda, Los Angeles and Palm Beach (FL) Counties) are exceptions, and their success is largely a product of developing a clear need and formal efforts to achieve public support for funding these needs. Such efforts have not been fully tested in San Diego.

- *Optimizing Current Resources.* One of the challenges for trauma centers in developing a public-funded effort is to assure that all current revenue opportunities are optimized. All trauma centers indicated that they had oppor-

tunities to improve revenue for trauma care and several indicated and were observed to have potential for significant improvement. These trauma centers should undertake high-priority efforts to achieve those potentials.

- *County Funding.* There do not appear to be any resources at the County level for direct trauma center funding beyond those that are in place today (e.g. SB 12/612 funding). Even so, such County funding would likely come with significant audit and review responsibilities for the trauma centers, and from a resource and cost standpoint, may obviate the modest County funding that might be available. The County has indicated a commitment to assist the trauma centers in locating stable sources of funding for the trauma centers and system leadership at the County level.
- *Statement of Need.* Consistent with previous observations in this report, a clearer statement of need for public support should be developed by the trauma system to provide a stable and sustainable source of funding for the future. The funding would be used to assist the trauma centers and EMS Agency. This effort should be followed by a careful analysis of public support for developing a stable source of funding for the system, perhaps through a tax initiative, and then pursuing that initiative.
- *Pursue Stable Funding Sources.* Pursuing stable funding sources for the trauma system should be a high priority as future changes to the system appear to assure a widening gap between cost and revenue. The planning for a stable funding source might be included in the MAC strategic initiatives mentioned previously.



VI. Appendices



Appendix A: Study Participants

San Diego County Trauma System Assessment Study Participants			
Category	Name	Title	Affiliation
Ambulance	Dallas Johnson	Operations Supervisor	AMR
Ambulance	Theresa Matlock	EMT-P	AMR
Ambulance	Anna Rangel	EMT-P	AMR
Ambulance	Kelly Forman, RN	Business Development Coordinator	Mercy Air
Ambulance	Pam Steen, RN	Former Trauma QA Specialist	Mercy Air
Ambulance	Wayne Johnson	Director of Operations	San Diego Medical Services Enterprise
Ambulance	Devin Price	Member of Emergency Medical Care Committee	San Diego County Paramedic Association
Ambulance	Ann Loring, RN	Nurse Coordinator	Schafer Ambulance Services
Ambulance	David Harker	EMT-P	Sycuan Ambulance
County	Susan Barnes, RN	Public Health Nurse III	Adult Protective Services
County	Carmen Duron, RN	Public Health Nurse III	Adult Protective Services/AIS
County	Brian Blackbourne, MD	Medical Examiner	County of San Diego
County	Walter F Ekard	Chief Administrative Officer	County of San Diego
County	Nick Macchione	N Coastal/N Inland Region General Manager	County of San Diego
County	Betty Morell	South Region General Manager	County of San Diego
County	Patti Rahiser	N Central Region General Manager (acting)	County of San Diego
County	Rene Santiago	Central Region General Manager	County of San Diego
County	Jack Walsh, RN	Public Health Nurse	County of San Diego
County	Bonnie Copland, RN	Public Health Nurse III	East Region Public Health Center
County	Tamara Bannan	HPPS	Health & Human Services
County	Diane Hall, RN	Nurse Manager	Health & Human Services
County	Amy Hoover	Engineer Technician	Health & Human Services
County	Jackie Werth	Planning Specialist	Health & Human Services
County	Martha Bartzan	Public Health Nurse Manager	Health & Human Services/East Region
County	Rhonna Bunelle	Assistant Deputy Director	Health & Human Services/East Region
County	Elizabeth Villafranco	Student Intern	Health & Human Services/East Region
County	Carol Judkins, RN	Public Health Nurse Manager	Health & Human Services/North Central Region
County	E Lorentz	Health Promotions	Health & Human Services/North Region
County	Karen Mason	Mental Health Consultant	Health & Human Services/North Region
County	Carey Riccitelli	Health Specialist	Health & Human Services/North Region
County	Blair Hoppe	Legislative Analyst	Health & Human Services/South Region
County	Oscar Talaro	Community Liaison	Health & Human Services/South Region
County	Pilar Velasco	Protective Services	Health & Human Services/South Region
County	Gwenmarie Hillary	Assitant Deputy Director	Public Health Services
County	Gail F Cooper	Public Health Administrator	San Diego County Office of Public Health
County	Les Gardina, RN	Trauma QA Specialist	San Diego County EMS Agency
County	Gwen Jones	Chief of EMS	San Diego County EMS Agency
County	Nevea Ledesma	Trauma Program Assistant	San Diego County EMS Agency
County	Marcy Metz, RN	QA Specialist	San Diego County EMS Agency
County	Patti Murrin, RN, MPH	EMS Coordinator - Trauma	San Diego County EMS Agency
County	Sharon Pacyna, RN, BSN, MPH	QA Specialist/CIREN Manager	San Diego County EMS Agency
County	Leslie Upledger Ray, MA, MPPA	Senior Epidemiologist	San Diego County EMS Agency
County	Patty Danon	Deputy Chief of Staff	Supervisor Greg Cox's Office
County	Anthony Orlando	Senior Policy Advisor	Supervisor Ron Roberts' Office



Appendix A: Study Participants, cont.

San Diego County Trauma System Assessment Study Participants			
Category	Name	Title	Affiliation
Fire	Dick Gardner	Fire Captain	California Department of Forestry/Deer Springs
Fire	Shane Vargas	Firefighter II	California Department of Forestry/Deer Springs
Fire	Brian Watson	Division Chief	Carlsbad Fire Department
Fire	Tom Layman	Battalion Chief	Chula Vista Fire Department
Fire	Alan Nowakowski	Division Chief - EMS	Coronado Fire Department
Fire	Rodney Geilenfeldt	Paramedic	El Cajon Fire Department
Fire	Debra Murphy, RN, MICN	EMS Coordinator	Escondido Fire Department
Fire	Victor Reed	Fire Chief	Escondido Fire Department
Fire	Kevin Dubler	Fire Chief	Julian Fire Department
Fire	Andrew Parr	EMS Coordinator	Lakeside Fire Department
Fire	Jim Myers	EMS Chief	Oceanside Fire Department
Fire	Charles T Gahn	Chief	Ocotillo Wells Fire Department
Fire	Don Butz	Deputy Chief	Rancho Santa Fe Fire Protection District
Fire	Bruce Cartelli	Battalion Chief	San Diego Fire Department
Fire	Letto Contreras	Communications Center Manager	San Diego Fire Department
Fire	Roger Fisher	QA Manager	San Diego Fire Department
Fire	Patricia Nunez	Human Resources Manager	San Diego Fire Department
Fire	Ginger Ochs, RN	QI Manager	San Diego Fire Department
Fire	Mike Pacheco	Operations Coordinator	San Diego Fire Department
Fire	Perry Peak	Battalion Chief	San Diego Fire Department
Fire	Dave Power	Firefighter, EMT-P	San Diego Fire Department
Fire	Mark Sundberg	Firefighter, EMT-P	San Diego Fire Department
Fire	Rolf Trautwein	Captain	San Diego Fire Department
Fire	Jeff Tyranski	Firefighter, EMT-P	San Diego Fire Department
Fire	Andy Uzdiavines	Captain	San Diego Fire Department
Fire	Bret Eldridge	Captain/Former Paramedic	Santee Fire Department
Fire	Robert Ironside	Engineer	Santee Fire Department
Fire	Bob Pfohl	Fire Chief	Santee Fire Department
Fire	George K George	Fire Chief	Solana Beach Fire Department
Fire	Marilyn Anderson, RN	EMS Coordinator	Vista Fire Protection District
Fire	Tammy McGill	EMT	Warner Springs Volunteer Fire Department
Hospital	Paul Hartup	Interim ED Manager	Alvarado Hospital
Hospital	Louis Coffman	Chief Financial Officer	Children's Hospital & Health Center
Hospital	David DeBeck	Decision Support Analyst	Children's Hospital & Health Center
Hospital	Susan Duthie, MD	Assistant Director of Critical Care	Children's Hospital & Health Center
Hospital	Jim Harley, MD	Emergency Medicine	Children's Hospital & Health Center
Hospital	Buzz Kaufman, MD	Senior Vice President, Health Affairs	Children's Hospital & Health Center
Hospital	Donald Kearns, MD	Medical Director of Surgical Services	Children's Hospital & Health Center
Hospital	Cindy Kuelbs, MD	Medical Director Chadwick Center	Children's Hospital & Health Center
Hospital	Michael Levy, MD	Director of Pediatric Neurosurgery	Children's Hospital & Health Center
Hospital	Bradley Peterson, MD	Medical Director, Critical Care	Children's Hospital & Health Center
Hospital	Blair Sadler	Chief Executive Officer	Children's Hospital & Health Center
Hospital	Kathy Webb	Contracts	Children's Hospital & Health Center
Hospital	Jim Dunford, MD	Medical Director	City of San Diego/UCSD
Hospital	William Linnik, MD	Base Hospital Medical Director	Grossmont Hospital
Hospital	Mary Meadows-Pitt, RN	Base Hospital Nurse Coordinator	Grossmont Hospital
Hospital	Sharon Andrews, RN, MSN	Director of Adult Inpatient Services	Palomar Medical Center



Appendix A: Study Participants, cont.

San Diego County Trauma System Assessment Study Participants			
Category	Name	Title	Affiliation
Hospital	Barbara Bateman, RN, MBA	Director of Perioperative Services	Palomar Medical Center
Hospital	Shelley Berthiaume, RN	Base Hospital Nurse Coordinator	Palomar Medical Center
Hospital	Gerald Bracht	Chief Executive Officer	Palomar Medical Center
Hospital	LeAnne Cooney	Financial Planning/Decision Support	Palomar Medical Center
Hospital	Taylor Fletcher, MD	Emergency Medicine	Palomar Medical Center
Hospital	Michelle Grad, MD	Base Hospital Medical Director	Palomar Medical Center
Hospital	Bob Hemker	Chief Financial Officer	Palomar Medical Center
Hospital	Pam Hoppie, RN	ED Nurse Manager	Palomar Medical Center
Hospital	Lourdes Januszewicks, RN, BSN, CCRN	Nurse Manager Critical Care Unit	Palomar Medical Center
Hospital	Catherine Konyon, RN, MSN	Nurse Manager/CNS Critical Care Unit	Palomar Medical Center
Hospital	Kevin Metros, MD	Orthopedic Surgeon	Palomar Medical Center
Hospital	Gabriella Morris, MD	Neurosurgeon	Palomar Medical Center
Hospital	Raluan Soltero, MD	Plastic Surgeon	Palomar Medical Center
Hospital	Kathleen Stacy, RN, MSN, CCRN	Nurse Manager Intermediate Care Unit	Palomar Medical Center
Hospital	Arlene Cawthorne	Community Research Specialist	Palomar/Pomerado Behavioral Health
Hospital	Kevin Anderson	Finance	Scripps Healthcare
Hospital	Lisa Otte	Cost Accounting Manager	Scripps Healthcare
Hospital	Kay Young	Fiscal Director	Scripps Healthcare
Hospital	Linda Broyles, RN	Base Hospital Nurse Coordinator	Scripps Memorial Hospital - Chula Vista
Hospital	Mary Margeret Leohr, MD	Base Hospital Medical Director	Scripps Memorial Hospital - Chula Vista
Hospital	Mel Ochs, MD	Former EMS Medical Director	Scripps Memorial Hospital - Chula Vista
Hospital	John Armstrong	Finance	Scripps Memorial Hospital - La Jolla
Hospital	Andrew Cliff	Senior Financial Analyst	Scripps Memorial Hospital - La Jolla
Hospital	Sean Evans, MD	Base Hospital Medical Director	Scripps Memorial Hospital - La Jolla
Hospital	Gary Fybel	Chief Executive Officer	Scripps Memorial Hospital - La Jolla
Hospital	David Hackley, MD	Orthopedic Surgeon	Scripps Memorial Hospital - La Jolla
Hospital	Mary Johnson, RN	Base Hospital Nurse Coordinator	Scripps Memorial Hospital - La Jolla
Hospital	Cindy Steckel, RN	Trauma Administrator	Scripps Memorial Hospital - La Jolla
Hospital	Lisa Thackur	Director of Fiscal Services	Scripps Memorial Hospital - La Jolla
Hospital	Lance Alteneau, MD	Neurosurgeon	Scripps Mercy Hospital & Medical Center
Hospital	Melissa Burns, RN	ICU Nurse Manager	Scripps Mercy Hospital & Medical Center
Hospital	Davis L Cracraft, MD	Chief of Staff	Scripps Mercy Hospital & Medical Center
Hospital	Kent Dively, MD	Anesthesiologist	Scripps Mercy Hospital & Medical Center
Hospital	Tom Gammieri	Chief Executive Officer	Scripps Mercy Hospital & Medical Center
Hospital	Leanne Hunstock, RN	Chief Nurse Executive	Scripps Mercy Hospital & Medical Center
Hospital	Barbara Loma, RN	Nurse Practitioner	Scripps Mercy Hospital & Medical Center
Hospital	Sheri Mankin	ED Manager	Scripps Mercy Hospital & Medical Center
Hospital	Kim McEvoy	Director, Surgical Services	Scripps Mercy Hospital & Medical Center
Hospital	Linda Rod, RN	Nurse Practitioner	Scripps Mercy Hospital & Medical Center
Hospital	Jackie Saucier	ED Manager	Scripps Mercy Hospital & Medical Center
Hospital	David J Shaw, MD	MD Specialist	Scripps Mercy Hospital & Medical Center
Hospital	Charles W Simmons, MD	ED Medical Director	Scripps Mercy Hospital & Medical Center
Hospital	William Tontz, MD	Orthopedic Surgeon	Scripps Mercy Hospital & Medical Center
Hospital	Michael Lenihan, MD	Orthopedic Surgeon	Sharp Chula Vista Medical Center
Hospital	Dan Gross	Chief Executive Officer	Sharp Memorial Hospital
Hospital	Mark Kramer, MD	Base Hospital Medical Director	Sharp Memorial Hospital
Hospital	Sharon Rudnick, RN	Nurse Coordinator	Sharp Memorial Hospital
Hospital	Susan Smith, RN	Base Hospital Nurse Coordinator	Sharp Memorial Hospital
Hospital	Kevin Thompson	Chief Financial Officer	Sharp Memorial Hospital



Appendix A: Study Participants, cont.

San Diego County Trauma System Assessment Study Participants			
Category	Name	Title	Affiliation
Hospital	Beth N Liguon	Director	Tri-City Medical Center
Hospital	Dori Vroman, RN	Base Hospital Nurse Coordinator	Tri-City Medical Center
Hospital	Todd Zaayer, MD	Base Hospital Medical Director	Tri-City Medical Center
Hospital	Lana Brown, RN	Base Hospital Nurse Coordinator	UCSD (AMR) Base
County	Gary Vilke, MD	EMS Medical Director	San Diego County EMS Agency
Hospital	Karilyn Greenwood	Director of Decision Support	UCSD Medical Center
Hospital	David Guss, MD	Emergency Department	UCSD Medical Center
Hospital	Robert Hogan	CFO/Director of Financial Administration	UCSD Medical Center
Hospital	Sumiyo Kastelic	Administrator	UCSD Medical Center
Hospital	Kathy Bay, CNS	Emergency Department	United States Naval Hospital
Hospital	David Tam, MD	Director of Branch Medical Clinics	United States Naval Hospital
Non-Trauma	Pat Coakley	Director	Kaiser Foundation Hospital
Non-Trauma	Stephanie Baker, RN, CEN, BSN	Director of Emergency Services	Paradise Valley Hospital
Non-Trauma	Trish McAvliffe, RN	Nurse	Villa View Community Hospital
Organizations	Linda Peek	Associate Director	Altam Associates
Organizations	Grover Diemert	Executive Director	Bayside Community Center
Organizations	Lisa Cardenas	Program Coordinator	CA Perinatal Transport System
Organizations	Catureena San Juan King	Program Coordinator	CA Perinatal Transport System
Organizations	Nicki Clay	Partner	Clay & Associates
Organizations	Stephanie Saathoff	Associate	Clay & Associates
Organizations	Heather Summers	Violence Prevention Specialist	El Cajon Collaborative ECVR
Organizations	Kevin Hutton, MD	CEO/President	Golden Hour Data Systems
Organizations	Bradford Burnett, MD, MBA	Member	Health Services Advisory Board
Organizations	Steven A Escoboza	CEO/President	Healthcare Assoc of San Diego & Imperial Counties
Organizations	Sonja Fulton	Director of Program Development	Healthcare Assoc of San Diego & Imperial Counties
Organizations	Liz Kruidenier	Social Policy Chair	League of Women Voters - North Coast
Organizations	Katherine Smith-Blanke	Chair	Mental Health Board
Organizations	Cindy Lechien	Director of Operations	Mountain Health & Community Services
Organizations	Trina Souza, RN	RN Clinical Coordinator	Mountain Health & Community Services
Organizations	Bob Borden	Coordinator/Teacher	National Alliance for Mental Illness
Organizations	Bob Brooks	Coordinator	National Alliance for Mental Illness
Organizations	Roxanne Hoffman	Coordinator	Safe Kids Coalition
Organizations	Mike Casinelli	Executive Director	Trauma Research Education Foundation
Organizations	Myrtle Cassell	Director	Warner Community Resource Center
Other	Dean Stowers	Police Officer	California Highway Patrol
Other	Nicky Fontitus, MD	Physician	North County Collaborative
Other	Brad Wiscons	E.D.	North County Collaborative
Other	Debi Moffat	Director of EMS	Palomar College
Other	John Seiferth	Deputy	San Diego County Sheriff
Other	Jo Chappel, RN	EdD	Sweetwater Union High School District
Other	Francis Deogracias	US INS	US INS
Other	Steven Whiteley	US INS	US INS
Trauma	Sue Cox, RN, MS, CEN	Trauma Nurse Manager	Children's Hospital & Health Center
Trauma	Renee Douglas, RN	Trauma Clinical Coordinator	Children's Hospital & Health Center
Trauma	Barry LoSasso, MD, FACS, FAAP	Trauma Medical Director	Children's Hospital & Health Center
Trauma	Laura Maresh	Trauma Registrar	Children's Hospital & Health Center
Trauma	Berda Taylor	Trauma Business Unit Coordinator	Children's Hospital & Health Center
Trauma	C Douglas Wallace, MD	Director of Orthopedic Trauma	Children's Hospital & Health Center



Appendix A: Study Participants, cont.

San Diego County Trauma System Assessment Study Participants			
Category	Name	Title	Affiliation
Trauma	Lawrence Marshall, MD	Director of Neurosurgical Trauma	Children's Hospital & Health Center/UCSD
Trauma	Kim Colonelli, RN, MA	Trauma Nurse Manager	Palomar Medical Center
Trauma	Shannon Durbin-Yates, RN, BSN	Trauma Clinician	Palomar Medical Center
Trauma	Maureen Goehring, RN	Former Trauma Nurse Manager	Palomar Medical Center
Trauma	Patricia Renaldo, RN, BSN	Trauma Clinician	Palomar Medical Center
Trauma	Sally Valle	Department Secretary	Palomar Medical Center
Trauma	Thomas Velky, MD	Trauma Medical Director	Palomar Medical Center
Trauma	A Brent Eastman, MD, FACS	Trauma Medical Director	Scripps Memorial Hospital - La Jolla
Trauma	Jackie Martinez, RN, BSN, CCRN	Trauma Case Manager	Scripps Memorial Hospital - La Jolla
Trauma	Brian McCord	ICU Manager	Scripps Memorial Hospital - La Jolla
Trauma	Monte Mellon, MD	Chair ED	Scripps Memorial Hospital - La Jolla
Trauma	Richard Ostrup, MD	Neurosurgeon	Scripps Memorial Hospital - La Jolla
Trauma	Marc M Sedwitz, MD	Trauma Surgeon	Scripps Memorial Hospital - La Jolla
Trauma	Fred Smith, Jr, MD	Director of Trauma	Scripps Memorial Hospital - La Jolla
Trauma	Steve Wickham, RN, MN	Director of Emergency Department and Trauma	Scripps Memorial Hospital - La Jolla
Trauma	Jennifer Wilson, RN, BSN, ONC	Trauma Case Manager	Scripps Memorial Hospital - La Jolla
Trauma	Cheryl Wooten, MSN, RN, CNRN	Trauma Nurse Manager	Scripps Memorial Hospital - La Jolla
Trauma	Michael Egan, MD	Trauma Surgeon	Scripps Mercy Hospital & Medical Center
Trauma	Dot Kelley, RN, MSN, CEN	Trauma Nurse Manager	Scripps Mercy Hospital & Medical Center
Trauma	Bonnie Lutz	Trauma Registry	Scripps Mercy Hospital & Medical Center
Trauma	Michael Sise, MD, FACS	Trauma Medical Director	Scripps Mercy Hospital & Medical Center
Trauma	Beth Sise, JD, RN, MSN, CPNP	Director, Injury Prevention and Outreach	Scripps Mercy Hospital & Medical Center
Trauma	Jack C Yang, MD	Trauma Surgeon	Scripps Mercy Hospital & Medical Center
Trauma	Kathi Ayers, RN, MSN, MSNP	Trauma Nurse Manager	Sharp Memorial Hospital
Trauma	Frank Kennedy, MD, FACS	Trauma Medical Director	Sharp Memorial Hospital
Trauma	Janie Taylor, RN	Trauma Administrator	Sharp Memorial Hospital
Trauma	Dale Fortlage	Trauma Registrar	UCSD Medical Center
Trauma	Jennifer Hall	Trauma Case Manager	UCSD Medical Center
Trauma	Peggy Hollingsworth-Fridlund, RN, BSN	Trauma Nurse Manager	UCSD Medical Center
Trauma	David Hoyt, MD, FACS	Trauma Medical Director	UCSD Medical Center
Trauma	Alexandra Schwartz, MD	Chief of Trauma/Orthopedics Division	UCSD Medical Center
Trauma	Patricia Stout, RN	Trauma Registrar	UCSD Medical Center
Trauma	Jeff Smith, MD	Orthopedic Surgeon	UCSD Medical Center/CIREN



Appendix B: The Abaris Group Team

The following expert team members and Abaris staff were consulted with and contributed to this study:

Principal investigators:

Pennie Klein, RN, MA Lead Trauma System Nurse Expert

Ms. Klein has been working in trauma and trauma systems since the 1980's and has extensive experience in trauma system and trauma center level management. She is the recent past Trauma System Coordinator for the State of Arizona, where she had overall responsibility for the development and monitoring of the state trauma program.

Kimball Maull, MD Lead Physician Consultant

Dr. Maull is Director of the Carraway Trauma Center, Attending Surgeon and Director of the Surgery Residency Program at Carraway Methodist Medical Center in Birmingham, Alabama. He is also a Senior Scientist at the University of Alabama at Birmingham's Injury Control Research Center. Dr. Maull is the recent past Medical Co-Director for the National Highway Traffic Safety Administration (NHTSA) and the U.S. Department of Transportation (DOT) National EMT-B Standard Curriculum (1990-94). He has had many academic and professional appointments related to trauma and numerous articles (158) and presentations (325) to his credit regarding EMS/trauma systems.

Mike Williams, MPA/HSA Project Director

Mike has been the president of The Abaris Group for the past 13 years and has been a full-time EMS consultant for the past 22 years. Before consulting, he was Director of the Office of Emergency Medical Services for Orange and Imperial Counties, California. Mike is a long-standing member of the American Trauma Society and is a nationally recognized speaker on the subject of accountability and performance in the emergency-care field.

Other professional and consultative staff:

Chuck Baucom Database & GIS/Mapping Expert

Mr. Baucom has assisted The Abaris Group with data management and mapping resources with numerous EMS consulting projects in Idaho, Colorado and California. Mr. Baucom is the EMS Administrator for the County of Merced and has been involved in emergency medical services since 1973.

Denis David Bensard, MD Pediatric Trauma Surgeon Consultant

Dr. Bensard is Associate Professor of Surgery in the Pediatric Surgery Division at University of Colorado (CU) School of Medicine. He has held numerous academic appointments including: Assistant Professor of Surgery and Pediatrics and Pediatric Surgery at CU, Director of Surgical Intensive Care Unit at Veteran's Administration Hospital, Director of Trauma at Children's Hospital Regional Trauma Center, Council Member Adam's County Trauma Advisory Council, and Surgical Co-Director of ICU at Children's.

Pam Goslar, Ph.D., CPA Injury Epidemiologist Expert

Dr. Goslar has worked in the field of injury epidemiology for approximately ten years. For the past two years she has been at St. Joseph's Hospital and Medical Center, an ACS verified Level I Trauma Center in Phoenix, Arizona, where she is responsible for building the Trauma Prevention and Outcomes Research Program. She has served on a variety of state and local trauma committees.



Heidi Hotz, RN Trauma System Nurse Expert

Ms. Hotz's experience in trauma care, trauma systems, and trauma program management span 20 years. She is currently the Trauma Program Manager at Cedars-Sinai Medical Center in Los Angeles and maintains membership on the LA County Trauma Hospital Advisory Committee. She is also the President of the Society of Trauma Nurses.

Jonathan Jui, MD, MPH EMS/EDMD Physician Consultant

Dr. Jui is a Professor in Emergency Medicine at Oregon Health Sciences and University (OHSU), Portland, Oregon and a nationally recognized EMS system medical director. He is board certified in Emergency Medicine, Infectious Disease, and Internal Medicine. He serves on many committees in Oregon. He also holds a Masters in Public Health in Epidemiology from the University of Washington.

Peter Letarte, MD Trauma Neurosurgeon Consultant

Dr. Letarte is an Assistant Professor of Neurological Surgery at Loyola University Medical Center, Illinois with a specific interest in Neurotrauma, Critical Care, Spinal Surgery, Peripheral Nerve and General Neurosurgery. He served eight years in the military as a U.S. Naval Flight Surgeon in Japan, Florida, and Pennsylvania. Dr. Letarte is board certified by the National Board of Medical Examiners and is a diplomat of the American Board of Neurological Surgery.

Ernest Moore, MD, FACS, FCCM, FACN Trauma Physician Consultant

Dr. Moore has been the Chief of Trauma Services at the Rocky Mountain Regional Trauma Center, Denver Health Medical Center since 1976. He is also the Chief of the Department of Surgery at Denver Health Medical Center, Professor of Surgery and the Vice Chair of the Surgery Department at the University of Colorado Health Sciences Center. Dr. Moore is also extensively published. He is co-author of

"Trauma," now in its 5th edition, and a contributing author to the American College of Surgeons Committee on Trauma's "Resources for Optimal Care of the Injured Patient" (1993 and 1999 editions).

Bev Ness, RN, BSN Trauma System Nurse Expert

Ms. Ness has worked with The Abaris Group for nearly seven years as a strategic planning and project coordination expert on a variety of trauma projects. Her past experience includes trauma system manager for the Nor-Cal EMS, Inc. region for eight years, and she was the Trauma Nurse Coordinator for the State of Arizona for three years. She has also written trauma plans for Northern California EMS, Inc., Riverside County and for the Fresno, Kings, Madera EMS region.

Wade Smith, MD Trauma Orthopedic Surgeon Consultant

Dr. Smith is the Director of the Department of Orthopedic Surgery at the Rocky Mountain Regional Trauma Center at Denver Health Medical Center. He is also the Director of the Alpha Omega Trauma Fellowship at Denver Health Medical Center. He is presently appointed as the Assistant Professor of Orthopedic Surgery at the University of Colorado Health Sciences Center. Dr. Smith has also served as the Co-Director of Orthopedic Trauma at Denver Health Medical Center for the past four years.

Taylor Bluske Executive Assistant

Taylor is Executive Assistant at The Abaris Group. Along with maintaining company accounts and bookkeeping, Taylor provides program coordination, client report preparation, and report graphics and design. Her previous experience includes working as a dispatcher for the Contra Costa County Sheriff's Office.

Juliana C. Boyle, MBA Economist

Juliana is a full-time economist for The Abaris Group and has worked with the firm for almost 8 years. She has many years of experience analyzing a wide range of health related data. Her



experience includes seven years as an economist with the University of New Mexico, Bureau of Business and Economic Research and five years as a policy analyst/economist for the State of New Mexico, where she was involved in analyzing various health care reform proposals and their potential impact on the state.

Carla Gomez Research Assistant

Carla is a Research Assistant at The Abaris Group. Carla graduated from University of California, Berkeley with a Bachelor of Arts in Rhetoric. She provides research support for projects, assists with data and client report preparation, and spreadsheet calculations.

Jonathan Willis Research Assistant

Jonathan is a Research Assistant at The Abaris Group. Jonathan has a Bachelor of Arts in Economics from the University of California, Berkeley. He has worked on a number of projects including the research and publication of best practice policies on emergency department diversion and the development of research tools to assess compensation issues for trauma surgeons.



Appendix C: Definitions

Abbreviated Injury Scale (AIS) - is an anatomic severity scoring system. For the purposes of data sharing, the standard to be followed is AIS 90. For the purpose of volume performance measurement auditing, the standard to be followed is AIS 90, using AIS code derived or computer derived scoring.

Advanced life support (ALS) - medically accepted, life sustaining, invasive procedures, provided at the direction of a physician or authorized registered nurse.

Ambulance service - a qualified provider of medical transportation for patients requiring treatment and/or monitoring due to illness or injury.

Base hospital - one of a limited number of hospitals which, upon entering into written contractual agreement with the local EMS agency, is responsible for directing the advanced life support system or limited advanced life support system assigned to it.

Basic life support (BLS) - medically accepted non-invasive procedures used to sustain life.

Catchment area - the geographic area served by a specified health care facility, trauma center or EMS agency.

Centralized EMS dispatch center - a system which is responsible for establishing communications channels and identifying the necessary equipment and facilities to permit immediate management and control of an EMS patient. This operation must provide access and availability to public safety resources essential to the effective and efficient EMS management of the immediate EMS problem.

Communications system - those resources and arrangements for notifying the EMS system of an emergency, for mobilizing and dispatching resources, for exchanging information, for remote monitoring of vital indicators, and for the radio transmission of treatment procedures and directions.

Definitive care - a level of therapeutic intervention capable of providing comprehensive health care services for a specific condition.

Designated facility - a hospital which has been designated by a local EMS agency to perform specified emergency medical services systems functions pursuant to guidelines established by the authority.

Emergency ambulance service - an emergency medical transport provider operating within an organized EMS system for the purpose of assuring twenty-four (24) hour availability of such services.

This pertains to all ground, air or water emergency medical transport.

Emergency department - the area of a licensed general acute care facility that customarily receives patients in need of emergent medical evaluation and/or care.

Emergency medical services (EMS) - the provision of services to patients requiring immediate assistance due to illness or injury, including access, response, rescue, prehospital and hospital treatment, and transportation.

EMS plan - a plan for the delivery of emergency medical services.

EMS system - a coordinated arrangement of resources (including personnel, equipment, and facilities) which are organized to respond to medical emergencies, regardless of the cause.

First responder - the first person (unit) dispatched to the scene of a medical emergency to provide patient care.

Health facility - any facility, place or building which is organized, maintained and operated for the diagnosis, care and treatment of human illness or injury, physical or mental, including convalescence, rehabilitation and/or pre- and post-natal care, for one or more persons, to which patients are admitted for twenty-four (24) hours or longer.

Hospital - an acute care hospital licensed under Chapter 2 (commencing with Section 1250) of Division 2, Health and Safety Code.

Immediately or immediately available - means unencumbered by conflicting duties or responsibilities; responding without delay when notified; and being physically available to the specified area of the trauma center when the patient is delivered in accordance with local EMS agency policies and procedures.

Inclusive trauma care system - means a system that is designed to meet the needs of all injured patients. The system shall be defined by the local EMS agency in its trauma care system plan.

Injury Severity Score (ISS) - means the sum of the squares of the Abbreviated Injury Scale score of the three most severely injured body regions.
Intervener physician - a physician on the scene of a medical emergency who offers to assist advanced life support personnel.

Medical control - physician responsibility for the development, implementation, and evaluation of the clinical aspects of an EMS system.



Appendix C: Definitions, cont.

Medical protocol - pre-established physician authorized procedures or guidelines for medical care of a specified clinical situation, based on patient presentation.

On-call - means agreeing to be available to respond to the trauma center in order to provide a defined service.

Over Triage - Over-triage is generally defined as those patients that did not need the services of a trauma center, usually translated as those patients triaged to a trauma center but sent home from the ED. Under-triage includes high risk patients that are transported to a non-trauma center or that go unrecognized as a high risk patient at a trauma center.

Prehospital emergency medical services - a sub-system of the emergency medical services system which provides medical services to patients requiring immediate assistance due to illness or injury, prior to the patient's arrival at an emergency medical facility.

Prehospital time - the interval of time between activation of the emergency medical transport response to an emergency incident and arrival of the emergency patient at a receiving facility.

Promptly or promptly available - means responding without delay when notified and requested to respond to the hospital; and being physically available to the specified area of the trauma center within a period of time that is medically prudent and in accordance with local EMS agency policies and procedures.

Provider - an organization, institution, or individual authorized to provide direct patient care.

Public safety agency - a functional division of a public agency which provides fire fighting, police, medical or other emergency services.

Public safety answering point (PSAP) - the location at which an emergency telephone call is answered and, either appropriate resources are dispatched or the request is relayed to the responding agency.

QANet - this is a real time, computerized wide area network (WAN) that is used to collect and store patient information and hospital resource availability and to link all emergency receiving hospitals, including trauma centers, base hospitals and SART facilities; ALA ambulances, including air medical providers; BLS ambulance providers; emergency

medical dispatch agencies and the Medical Examiners office.

Qualified specialist/qualified surgical specialist/qualified non-surgical specialist - means a physician licensed in California who is board certified in a specialty by the American Board of Medical Specialties, the Advisory Board for Osteopathic Specialties, a Canadian board or other appropriate foreign specialty board as determined by the American Board of Medical Specialties for that specialty.

(a) A non-board certified physician may be recognized as a "qualified specialist" by the local EMS agency upon substantiation of need by a trauma center if:

(1) the physician can demonstrate to the appropriate hospital body and the hospital is able to document that he/she has met requirements which are equivalent to those of the Accreditation Council for Graduate Medical Education (ACGME) or the Royal College of Physicians and Surgeons of Canada;

(2) the physician can clearly demonstrate to the appropriate hospital body that he/she has substantial education, training, and experience in treating and managing trauma patients which shall be tracked by the trauma quality improvement program; and (3) the physician has successfully completed a residency program.

Quality assurance/quality improvement - a method of evaluation of services provided, which includes defined standards, evaluation methodology(ies), and utilization of evaluation results for continued system improvement.

Receiving hospital - means a licensed general acute care hospital with a special permit for basic or comprehensive emergency service, which has not been designated as a trauma center according to this Chapter, but which has been formally assigned a role in the trauma care system by the local EMS agency. In rural areas, the local EMS agency may approve standby emergency service if basic or comprehensive services are not available.

Residency program - means a residency program of the trauma center or a residency program formally affiliated with a trauma center where senior residents can participate in educational rotations, which has been approved by the appropriate Residency Review Committee of the Accreditation Council on Graduate Medical Education.

Response time - the total interval from receipt of a request for medical assistance to the primary public safety answering point (PSAP) to arrival of the responding unit at the scene. This includes all dispatch intervals and driving time.



Appendix C: Definitions, cont.

SDEMSA - refers to the County of San Diego, Health and Human Services Agency, Diversion of Emergency Medical Services.

Secondary care - health care beyond the primary. Included are more sophisticated diagnostic methods and techniques, and laboratory facilities. This level of care is nearly available in medical care institutions serving a large population. (SOURCE: Tabors, 16th edition). Contrast with primary and tertiary care.

Senior resident or senior level resident - means a physician, licensed in the State of California, who has completed at least three (3) years of the residency or is in their last year of residency training and has the capability of initiating treatment and who is in training as a member of the residency program as defined in Section 100244 of this Chapter, at the designated trauma center.

Service area - means that geographic area defined by the local EMS agency in its trauma care system plan as the area served by a designated trauma center. The geographic area within which an EMS agency or health care facility provides service.

Statewide EMS system - a network of local EMS systems, integrated and coordinated at the state level.

Transfer agreement - a written agreement between health facilities providing reasonable assurance that transfer of patients will be effected between health facilities whenever such transfer is medically appropriate, as determined by the attending physician.

Transport time - the interval of time required for emergency medical transport of an ill or injured person from the scene of an emergency incident to arrival at a receiving facility.

Trauma care system - a subsystem within the EMS system designed to manage the treatment of the trauma patient.

Trauma Center or designated trauma center - means a licensed hospital, accredited by the Joint Commission on Accreditation of Healthcare Organizations, which has been designated as a Level I, II, III, or IV trauma center and/or Level I or II pediatric trauma center by the local EMS agency.

Trauma Resuscitation Area - means a designated area within a trauma center where trauma patients are evaluated upon arrival.

Trauma Service - is a clinical service established by the organized medical staff of a trauma center that has oversight and responsibility of the care of the trauma patient. It includes, but is not limited to, direct patient care services, administration, and as needed, support functions to provide medical care to injured persons.

Under Triage - Under-triage includes high risk patients that are transported to a non-trauma center or that go unrecognized as a high risk patient at a trauma center.



Appendix D: Best Practice Survey Summary Chart

Location	Leadership Structure	Triage System
Contra Costa County, CA	(Best) Trying to model after SD County	(Better) Policies/procedures/standards – meet monthly to review those for under and over-triage; bi-county meeting every other month (with Alameda), meet with trauma center every month; working to use Alameda standards, then eventually SDC standards for review of triage through MAC process
Florida	(Better) Strong commitment from trauma community, including trauma surgeons, program managers, state level	(Better) Very specific statewide standards and grant funding to look at under- and over-triage
Los Angeles County, CA	(Best) A Trauma Hospital Advisory Committee with multidisciplinary membership provides ongoing evaluation of all elements of the trauma system	(Best) Periodic reevaluation of triage criteria recently included creating a chart comparing the triage criteria of all CA trauma systems
Maryland	(Best) Have an independent state agency with regulatory and statutory authority; also an 11-member EMS board that answers directly to the governor; trauma is part of the state's EMS system	(Better+) Believes there is no perfect triage system in existence, but they do have statewide protocols, monitoring through the trauma registry, and a system of feedback between individual hospitals and prehospital providers
Orange County, CA	(Best) County has a Trauma Operations committee attended by the EMS Medical Director, EMS Program Manager, EMS Trauma Coordinator, and the Trauma Program Managers and Trauma Medical Directors of the county's three trauma centers	(Best)
Oregon	NR	(Better) Data from paramedic triage is sent to a central point in real time
Santa Clara County, CA	NR	(Better) Triage criteria are standardized and published; adopted from national standards with occasional modifications; looking at having a workgroup
Washington State	(Best) Have governor-appointed EMS and trauma steering committee with multidisciplinary membership of about 30, including prehospital, law enforcement, etc.; leadership is also provided by the Department of Health, Trauma and EMS Division	(Better) Have system-wide triage tool, destination protocols and trauma-specific treatment guidelines



Appendix D: Best Practice Survey Summary Chart, cont.

Location	EMS Provider Integration	Definitive and Rehabilitation Care
Contra Costa County, CA	(Better) One of the trauma MDs is going around to prehospital providers, teaching and asking about trauma triage; collaboratively done; MAC meeting every other month, with policy revisions being considered – all providers are invited to those	(Better) Trauma center is not ACS accredited; does have rehabilitation; does a very good job, but she's not aware of details of their best practices; an example of their commitment to innovative patient solutions is that they found rehabilitation for a South American patient in his home country, and made all the necessary arrangements
Florida	NR	(Better) Standards exceed ACS requirements; out-of-state specialists do on-site visits; there is a lot of follow up between trauma centers and rehabilitation care providers
Los Angeles County, CA	(Better) All policies go through committee process including prehospital involvement	(Best)
Maryland	(Best) Trauma is integrated into EMS training and protocols; prehospital providers also participate in case review with hospitals, sit on committees, etc.	(Best) Have a state process for designation/accreditation meeting or exceeding ACS standards; have statewide standards for transfers; have specialty centers (e.g. for hand care, burn care)
Orange County, CA	(Better) Strong coordination at the trauma center level to provide jointly sponsored educational programs	(Best)
Oregon	(Better/Best) Paramedics have been involved in the system's design and protocols from the very beginning	() Oregon's creation of the Level IV trauma center designation allowed rural hospitals that formerly would not have become trauma centers to do so; Level I trauma centers send staff to assist rural Level IVs
Santa Clara County, CA	(Better) Working to improve integration with quality review system, including greater EMS participation in pre-audit screening and the audit committee	(Best) Meeting ACS standards and moving beyond to do follow-up through the trauma registry on outcome and rehabilitation within a year or two after injury (e.g. by looking at a score in the registry showing improvement after rehabilitation)
Washington State	(Better) Prehospital providers are represented on all advisory committees; the Licensing and Certification Committee advises the state on all EMS policy; additionally, there is prehospital involvement on the eight regional steering groups	(Best) Separate designations for general care, pediatric care and trauma rehabilitation, with standards are based on ACS standards; written transfer guidelines are in place



Appendix D: Best Practice Survey Summary Chart, cont.

Location	Information Systems	Quality Review System
Contra Costa County, CA	(Best) Just updated to brand new system; can work collaboratively with trauma center, with both sides accessing and entering data, running reports; registry can and will include prehospital data once it's determined what it should be	(Best) QI conducted through trauma registry and trauma log, at MAC and bi-county meeting
Florida	(Best) All trauma centers are in 100% compliance with registry reporting requirements; key is having a dedicated person or two to work closely with the trauma centers	NR
Los Angeles County, CA	(Better) All patients transported to a trauma center are included in the trauma registry; data dictionary tells users how to enter data, and also how to extract it; periodic audits are used to promote excellence; registry data fields are changed when entries are inconsistent	(Best) A subcommittee under the Trauma Hospital Advisory Committee supplements the QI efforts of the region's trauma centers
Maryland	(Better+) Have a state trauma registry, and all hospitals use same software; State Trauma Improvement Council uses registry data to review	(Better) Case reviews are done at the local level; each trauma center is required to have ongoing trauma QI; at the state level, they review registry data, including death and disability, and perform recertification of trauma centers every five years
Orange County, CA	(Best) The same program is used for data tracking at all three trauma centers and the EMS agency	(Best)
Oregon	(Better) Statewide integrated software system with clear entry and output standards; data from statewide trauma registry are available for County operations, and are used to produce findings	NR
Santa Clara County, CA	(Better/Best) Well established trauma registry with emphasis on relevant data and trauma center data downloaded to central point	(Best) Developing outcome database to determine potentially preventable deaths; looking at trends; moving beyond registry data; looking at impact of changes in policies and protocols using database support, with conclusions that are statistically valid
Washington State	(Best) Prehospital personnel leave run sheets at the hospital, so data is linked with patient's hospital data in the statewide trauma registry; work is being done on a comprehensive EMS registry (one not exclusively for trauma)	(Better) There are eight regions responsible for multidisciplinary system QI; each designated service is required to have QI; the state uses the trauma registry for mainly hospital QI; each county's medical program director performs prehospital QI



Appendix D: Best Practice Survey Summary Chart, cont.

Location	Public Education/Outreach	Trauma Research
Contra Costa County, CA	(Best) Trauma center has full-time RN dedicated to injury prevention; it has long been recognized as outstanding in the community	NR
Florida	(Best) Excellent programs done at the discretion of the trauma centers	NR
Los Angeles County, CA	NR	(Best)
Maryland	(Better+) Very active in this area; all trauma centers are expected to do community intervention and education for trauma; the state division of the ATS is very active and also leads programs	(Better) The National Study Center and the School of Medicine at the University of Maryland work on multi-center studies of system issues, along with the Johns Hopkins School of Public Health, which provides epidemiological data
Orange County, CA	(Better) All trauma centers are very involved in prevention programs at the local level	NR
Oregon	NR	NR
Santa Clara County, CA	NR	(Best) Two Level I's are both involved in trauma research; additionally, there are surgeons on sabbatical working on research, in some cases with the EMS agency; a comparison of transports is being conducted in collaboration with other counties
Washington State	(Best) Each of eight regions has a program and a staff specialist for this component, and the state level works with them to look at data; individual hospitals are required to have their own injury prevention programs, with Level I and II centers required	(Best) Harborview is a Level I with a highly regarded Injury Prevention Research Center



Appendix D: Best Practice Survey Summary Chart, cont.

Location	Legislation and System Financing	Other
Contra Costa County, CA	(Best) Do get grants from the government; the trauma center has its system so well-tuned, it's functioning well on its own; excellent dedicated trauma social workers; they do what they need to do, get patients placed as needed (for example, South American placed in his home country for rehabilitation)	No specific other practices; however, there is an emphasis on the collaborative nature of the system, with the EMS agency and the trauma center working together as well as with prehospital/fire/ambulance companies
Florida	NR	NR
Los Angeles County, CA	NR	System in place to compensate private trauma hospitals for care of indigent patients (funding from a combination of Prop 99, other trauma care funds, SB612 funds, and supplemental funds from the Board of Supervisors)
Maryland	(Better) Operational aspects of the system are well-funded (e.g. oversight, training of EMTs)	The state agency has a very good (and frequent) working relationship with trauma program managers and medical directors; they try to use consensus-building for regulation and standards; there is an outstanding communications system based on a state-run EMS and trauma communications center that is able to perform tasks such as tracking occupancy rates of all hospitals (e.g. ORs full, critical bypass), advising on destination, etc.
Orange County, CA	(Best) Each trauma center is audited as to how public funds have been utilized prior to distribution of additional funding	
Oregon	NR	The referral pattern from Level IIIs and IVs is very strong
Santa Clara County, CA	(Better) Use SB12 to make sure trauma centers get reimbursement; the EMS agency is very supportive in assuring the trauma centers get funding and it is working with the trauma centers on their proposed budget	A lot of energy goes into ensuring that the trauma registry is useful to users as well as the system in general; there is an annual users meeting; there is an annual system report that is 1) directed toward the educated layperson as well as the health care provider and 2) anticipated to soon include information about research being conducted at the trauma centers; finally, the EMS agency has taken an active role in the management of MCIs
Washington State	(Best) Relatively stable state trauma fund; funding from surcharges on vehicle licensing and traffic violations; matching of state with federal funds for trauma centers, with grants providing additional funding to hospitals that treat Dept. of Health Services patients and patients with a high ISS	Individual regions are responsible for planning and determining needs for prehospital/hospital trauma care; there are grassroots efforts and buy-in at the local level; prehospital providers are actively involved in planning/standards; trauma center designation is inclusive, including level V trauma centers, with almost all hospitals designated (except in King County, where designation is exclusive)



Appendix E: Comparison of Trauma Triage Criteria
for California Trauma Systems - Prepared by the
Los Angeles County EMS Agency, Nov. 2001.

Comparison of Triage Criteria Throughout California (by the Los Angeles County EMS Agency) November 2001						
Physiologic Criteria						
Region	Definition of Child	Adult B/P < 90	Child B/P	Respiratory Rate < 10 or > 29	GCS	RTS
Alameda County		X	X (No Limits Specified)	X	X = 12	Any Component = 3
Coastal Valleys	Child = < 15y	X	< 7y/ < 70 7-15y/ < 80		X = 13	
Contra Costa County						Uses CRAMS = 7 or > 7 w/major injuries
Fresno, Kings, Madera		X or S/S of Shock	X No Limits Specified		X = 13	X = 14
Inland Counties					X = 12	X = 12
Los Angeles County	Child = < 14y	X	X < 70		X BH w/ = 14	
Marin County	Child = < 14y	X		X	X = 13	
Northern Cal	Child = < 14y	X	X < 7y/ < 70 7-13y/ < 80	X	X = 13	
Orange County		X or HR < 50 or > 130	X < 70	X < 12 or > 30	X BH w/ < 12	
Riverside County		X "Hypotensive"	X "Hypotensive"	X "Compromise"	X = 13 or child = 10	X = 10
Sacramento County		X	X No Limits Specified	X	X < 14	
San Diego County	Child = < 14y	X	X < 60	X	X < 14	
San Francisco County		X or S/S of Shock		X	X < 13	X < 11
Santa Barbara County	Child = < 6y	X	X < 6y/ < 70		X < 14	
Santa Clara County		X	X = 6y/ < 60 > 6y/ < 90	X	X = 13	
Sierra-Sacramento Valley		X		X	X < 14	X < 11

X = Meets Trauma Center Criteria; C = Consideration for Transport to a Trauma Center



Appendix E: Comparison of Trauma Triage Criteria
for California Trauma Systems - Prepared by the
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Triage Criteria Comparison (Cont.)							
Region	Anatomic Criteria						
	All Penetrating Torso, Head, Neck, & Groin	Significant Blunt Trauma of the Head, Neck, or Trunk	Open or Depressed Skull Fracture	Flail Chest	Diffuse Abdominal Tenderness	Pelvic Fractures	Penetrating Injuries Proximal to the Knee or Elbow
Alameda County	X	C					X
Coastal Valleys	X Including Pelvis	X Including Pelvis	X	X		X	X
Contra Costa County	X Including Pelvis	C Including Pelvis					C
Fresno, Kings, Madera	X Excludes Groin						
Inland Counties	X Excludes Groin			X	X w/Blunt Trauma		X All Extremity Injuries w/Vascular Deficit
Los Angeles County	X SW to chest if between MCL			X	X		
Marin County	X Excludes Groin	X		X		X	
Northern Cal	X Excludes Groin		X	X		X	X
Orange County	X			X	C		
Riverside County	X Excludes Groin	X	X		X "Firm or Rigid Abdomen"		
Sacramento County	X Including Pelvis			X		X	X
San Diego County	X			X		X	X All Extremity Injuries w/Vascular Deficit
San Francisco County	X Excludes Groin	X Including Pelvis				X	X
Santa Barbara County	X SW to chest if between MCL					X	
Santa Clara County	X			X		X	X
Sierra- Sacramento Valley	X			X		X	X

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Appendix E: Comparison of Trauma Triage Criteria for California Trauma Systems - Prepared by the Los Angeles County EMS Agency, Nov. 2001.

Triage Criteria Comparison (Cont.)							
Anatomic Criteria (Cont.)							
Region	Proximal Long Bone Fractures = 2	Amputation Proximal to the Wrist or Ankle	Traumatic Paralysis	Penetrating Traumatic Arrest	Major Burns w/ Trauma	Patient at the Age Extremes	Precarious Medical History
Alameda County	X	X	X				
Coastal Valleys	X	X	X		X = 15% or Face &/or Airway	C < 5y or > 55y	C
Contra Costa County	X	X	X	X If ETA is brief	X	C	
Fresno, Kings, Madera					X		
Inland Counties			X or High Probability of Spinal Fx	X If ETA is brief			
Los Angeles County			X Spinal Injury w/Neuro Deficit	X w/Penetrating Torso		C	C
Marin County	X	X	X		X		
Northern Cal	X	X	X		X > 15% or Face &/or Airway	C < 5y or > 55y	C
Orange County	X Femurs Only		X Spinal Injury w/Neuro Deficit	X w/Penetrating Torso		C < 5y or > 60y	C
Riverside County	X or Single Femur Fx	X	X	X If < 8 min difference in ETA between Base & Trauma	X	C < 5y or > 55y	C
Sacramento County	X	X	X	X	X = 18% or Electrical Burn	X	
San Diego County	X	X	X		X	C < 5y or > 55y	C
San Francisco County	X	X	X		X Or Airway	C < 5y or > 55y	C
Santa Barbara County				X If < 8 min difference in ETA between Base & Trauma		C < 5y or > 55y	C
Santa Clara County	X Femurs Only	X	X Spinal Injury w/Neuro Deficit		X < 20%=TC > 20%=TC / Burn Center	C < 14y or > 55y	C
Sierra-Sacramento Valley	X	X	X		X		

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Appendix E: Comparison of Trauma Triage Criteria
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Triage Criteria Comparison (Cont.)					
		Mechanism Criteria			
Region	Falls	High Speed Vehicular Crashes	Major Vehicle Damage	Vehicle Rollovers	PSI
Alameda County	C =15 ft or > 10 ft if =14 y or =55 y		C	C w/o Restraints	C > 12 in
Coastal Valleys	X > 20 ft	X > 40 mph	X > 20 in	X w/o Restraints	X > 12 in
Contra Costa County	C =15 ft	C = 40 mph	C	C w/o Restraints	C > 12 in
Fresno, Kings, Madera	C = 20 ft				
Inland Counties	X > 20 ft	X > 30 mph			X
Los Angeles County	X > 15 ft				X
Marin County	X > 20 ft	X	X > 20 in	X w/o Restraints	X > 12 in
Northern Cal	X > 20 ft	X > 40 mph	X > 20 in	X w/o Restraints	X > 12 in
Orange County	C > 15 ft	C > 40 mph			
Riverside County	X > 10 ft		C > 20 in	X	C > 12 in
Sacramento County	X > 20 ft				
San Diego County	X > 15 ft or 3x patient's height	X > 40 mph	X	X w/o Restraints	X > 12 in frontal or 8 in side
San Francisco County	X > 20 ft	X > 40 mph or Velocity change of > 20 mph	X > 20 in	X	X > 12 in
Santa Barbara County					
Santa Clara County	X > 15 ft or > 10 ft for Pediatric Pt.	X > 35 mph	X > 20 in	X w/o Restraints	X
Sierra- Sacramento Valley	C > 20 ft	C > 40 mph	C > 20 in	C	C > 12 in

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Triage Criteria Comparison (Cont.)					
Mechanism Criteria (Cont.)					
Region	Extrication	Ejection	Death in same Vehicle	MCA >20 mph or separation of bike & rider	Auto vs Pedestrian or vs Bicycle
Alameda County	C > 20 min	C	C		C = 20 mph or =14y or =55y
Coastal Valleys	X > 20 min	X	X	X	X > 5 mph
Contra Costa County	C No time	C	C		C > 15 mph or <14y no mph
Fresno, Kings, Madera				C Non-amb w/potential sig. injury no mph	C Non-amb w/potential sig. injury
Inland Counties	X > 30 min	X	X w/injury or complaint		X > 10 mph
Los Angeles County	C No time	C	C w/injury or complaint		C
Marin County	X "Prolonged"	X		X	X > 5 mph
Northern Cal	X > 20 min	X	X	X	X > 5 mph
Orange County	C > 20 min	C		C	X > 20 mph or thrown 15 ft
Riverside County	X > 20 min	X	X	X	X
Sacramento County	X > 20 min	X	X		X > 5 mph
San Diego County		X		X	X > 5 mph
San Francisco County	X > 20 min	X	X	X	X > 5 mph
Santa Barbara County					
Santa Clara County	X "Prolonged"	X	X	X	X > 5 mph
Sierra-Sacramento Valley	C > 20 min	C	C	C	C > 5 mph

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